THE DYNAMIC FOUNDATION OF KNOWLEDGE

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BY

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LONDON

KEGAN PAUL, TRENCH, TRÜBNER & CO. LTD.

BROADWAY HOUSE, 68–74 CARTER LANE, E.C.

1913

PREFACE

It is now a long time since the writer of the following pages first thought of a dynamical interpretation of the concept of Matter. After some years of consideration and discussion he expressed his views in print in an essay entitled *Matter and Energy: Are there two Real Things in the Physical Universe?* This essay was published in 1887. A second essay was published in 1897 under the title, *The Doctrine of Energy: A Theory of Reality.* In these essays he maintained that the scientific concept of energy adequately explains the phenomena of nature, and that the inconsistent concept of material reality should be finally abandoned.

The question referred to has made great apparent progress since the date first mentioned above. The foolish abuse with which in certain quarters such ideas were then greeted has disappeared. They might now almost be called popular.

In philosophical journals they are constantly referred to, whilst as integral parts of scientific theory they are accepted and employed by many high authorities. The successors of some who looked upon them with dislike and derision seem even disposed to claim them as their own.

The present writer might perhaps regard these facts as indicating that he started his speculative journey along the right road. Possibly it may also be thought that there is now no further need for continuing the inquiry. To him it seems that such a view would be erroneous. We cannot say that the goal has yet been reached or that a foundation of definite concepts has yet been surely laid for physical knowledge. The elusive developments of recent scientific theory in various directions appear rather to render the task of seeking such a foundation more imperative than ever.

The highest powers of mathematical analysis—the necessary instrument of physical research—do not imply a clear definition of fundamental conceptions. The writer had occasion in his first essay to draw attention to obvious contradictions in the definitions of Matter and Force as employed by scientific writers of the time. Much more fully the same subject was dealt with in one of the ablest essays which the nineteenth century produced, the well-known treatise on the *Concepts of Physics*, by Mr. J. B. Stallo. Physicians and mathematicians sometimes seem to resent such criticisms. But they are at present essential to the attainment of truth.

Amongst metaphysicians, again, the apprehension of the instrumentary conceptions of Physics is sometimes almost incredibly crude and contradictory. Here also investigation and careful definition are very much required.

But criticism must be followed up by construction. This, unfortunately, Mr. Stallo hardly attempted, and amidst the flux of theories it might perhaps seem as if such an attempt must be hopeless. The present writer is convinced that there is no ground for despair, but that if we could arrive at the true source and origin of our Cognitions of the External, our physical concepts would become as clear and definite as those of mathematics. He believes, indeed, that recent advances in physical theory offer a very promising key to the solution of the problem.

Archimedes asked but a fulcrum that he might move the World. Such a fulcrum or basis for our conceptions of Nature is what we want to-day.

In the following pages the writer offers a small but sincere contribution to such an inquiry. He is conscious that his essay is necessarily very imperfect. A more serious fault in the eyes of some may probably be that he presumes to investigate ideas which competent students of science often accept or imagine that they accept without question. But that cannot be helped; and he must leave the arguments by which he endeavours to support his position to speak for themselves.

An important confirmation of the views suggested in the following pages is to be found in the theory of the nature of language as an expression of action.

The year 1887, in which the writer's first essay was published, was also the year in which the late Professor Max Müller's work on *The Science of Thought* first saw the light. Well aware that his

views were widely questioned, but with a serene conviction of their ultimate justification, the great philologist put his theory before the world. The present writer is not to be understood as accepting Max Müller's doctrine in its entirety, but he is satisfied that it contains an important element of truth, the value of which as an aid to clear conceptions of the External World he has endeavoured to point out.

The subject discussed in the following pages is the most practical of problems. "Man may do many things," said Goethe, "but he may not live at random." The aphorism is as true of the race as it is of the individual. The sailor as he leaves the shore behind must always have some datum from which to make his reckoning, and when at length he ventures on the boundless ocean he must have a compass *on board.* It is the same with those who would navigate the ship of Science. A cosmography served them for long. Nothing but a true theory of cognition can save them now.

The races of Europe for centuries made no intellectual progress. Had they delayed any longer than they did to assimilate the Copernican Astronomy they were doomed. If they fail now to solve the problem of knowledge they will perish. Without some objective and evident standard of truth, Science cannot be distinguished from quackery, nor fact from fad, nor law from licence. The danger of such confusion is real and imminent in Europe and America to-day.

As M. Paul Bourget has well remarked, "The true synonym of Evolution is not change but permanence. A being in evolving seeks its own conservation by adapting itself to its environment. When it ceases so to evolve it dies."

Agnosticism claims to be the creed of Science. Originally the claim had reference only to the supernatural. It threatens now to invade the proper domain of natural knowledge. Yet if knowledge is unattainable Science cannot exist.

Already on every hand the urgent need is felt for some definite criterion of truth. We find mathematical knowledge declared to be empirical. The law courts have recently declined more than once the duty of distinguishing between medical science and quackery. In economics what are scientifically obvious fallacies form the creed and teaching of thousands. In politics the socialist is perpetually being duped by the faddist. If dynamics has as yet escaped, it is only because it is constantly protected by practical tests. Impressionism, having conquered Art, seeks to embrace Science, and is already enveloping Education. Metaphysics is a welter of despairing compromises. Civilisation moves rather towards a chaos than towards a cosmos. Surely, therefore, the task attempted in the following pages—whether it be successfully accomplished or no—is at least one which should engage the attention of every thoughtful man.

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I

THE SENSIBLE WORLD

THE sensible world is mutation—a constant process of change.

We are, indeed, accustomed to admit and cannot ignore the fact of constant change and movement amongst the objects of sense.

But those objects themselves, or some of them, are, we think, continuously identical *things*—comparatively steadfast and abiding. The existence of such fixed points is, indeed, necessary to the recognition of change. We can only know differences by contrast. Without the opportunity of comparing the mutable with the constant the notion of change or movement could not arise. Without a relatively fixed datum the perception of change would be impossible.

It is thus that we perceive incessant change *amidst* the objects of sense. But what we do not at first realise is that *the sensible is itself mutation.*

It consists in changes occurring in something else which undergoes these changes. And in the primary fact of sensation we are conscious not at all of *that which changes, but solely and only of the change.*

When we observe a man walking, or the branch of a tree waving in the air, we perceive both the object which moves and its motion. Such movements of the objects of sense are, so to speak, facts superposed upon these objects, which themselves constitute the sensible datum of experience. But that datum itself is a transmutation, and that transmutation is the fundamental starting-point. We cannot in its case perceive also and in addition *the thing which is transmuted.*

The fixed datum with which movement is contrasted is, in fact, always only relatively fixed. But in the case of our primary experiences we cannot directly advance to the perception of that further datum, the changes in which constitute our sensations. We are, therefore, apt to overlook the fact that the sensible is nothing but mutation.

No doubt many of the main elements of the sensible phenomenal world exhibit great permanence and stability. But that does not at all affect our argument. Our point is, not that phenomena are changeable, but that they are changes. Their very nature and essence is mutation; their very permanence is a permanence of change.

Take the case of a ray or pencil of light. It is, in fact, a rapid stream of undulations; but it appears to vision a rigid and motionless beam. Accepting

this as a unit we may, by putting in motion the luminous source from which it issues, cause visible movement of the ray itself. In such a case vision perceives not merely the movement of the ray but the ray itself which moves. But viewing the ray as a compound of wave-motions, we perceive only the sensible result of the undulations and not that which undulates.

It is, indeed, possible, by a more minute examination, to analyse and disintegrate the ray, and perhaps to discover what we think are the constituents in which the undulation occurs. But that only carries us one step further back in the chain of data. It lets us understand that vision itself must be regarded as the result of undulations transmitted to and affecting the sensorium. It is the existence of such movements which gives rise to the sensation; and in sensation, therefore, it is clear that we are not conscious of the thing which changes, but that, on the contrary, the sensation is but the subjective aspect of what must be regarded objectively as a process of transmutation.

We might take as an illustration a waterfall. Apart from variations in the volume of the stream, the appearance of the fall at a given point is that of a constant and permanent object, yet we know that it is composed of rapid and incessant movements, and that its apparent constancy and rigidity are due to the *constancy of the process* of transmutation or motion in which it consists.

We repeat, therefore, that the sensible appearance

is our fundamental datum; and that, consisting as it does in transmutation, we perceive in this case the transmutation merely and not that which is transmuted. Even those sensible appearances which seem comparatively fixed and immutable are, in truth, mutations, and their apparent constancy is, in point of fact, a constancy of change.

All reflective thought conducts to this conclusion. When I consider the earth and the heavens they appear to be a system of objects moving in regular and periodic harmony around a centre fixed. Some wanderers are observed, but these are gradually and more and more effectually assigned to their appointed places in the general order. Yet step by step man has been driven from the security of such a view. The periodicity and the harmony remain, but the fixity is proved delusive. We are successively dislodged from every fulcrum until we are forced to recognise that there is mutation everywhere; that fixity and movement alike are only relative terms, and that the only constancy to be found is a constancy of change.

When I examine the details of the sensible presentation I am driven to the same conclusion. I experience a sensation of sound; I say I hear a trumpet. But the statement is a veiled inference. I hear merely the sound which I associate with the thing or mental idea called a trumpet. And that sound, when I examine further, is resolvable into an undulation of particles, a vibration of the drums of the ear or of the nerves which lead from them to the

sensorium. And what I feel, what constitutes the sensation of sound, is evidently the undulation itself, not the particles which undulate, their presence, if unagitated, giving rise to no sensation.

I do not feel my organism when in its normal state. I feel merely the changes or transmutations which take place in the normal course of change. Sensation is not sensation of thing changing *and* of change. It is simple consciousness of *change*.

The same exciting cause may produce altogether different sensations, according to the portion of the organism affected. Thus an electrical current may produce the sensations of flashes of light, distinct sounds, phosphoric odours, a peculiar taste, or a feeling of pricking, according to the particular sensory nerve to which it is applied. (Carpenter, *Mental Physiology*, ch. iv. p. 132.)

To take a simpler instance: the pressure of the hands may produce a tactual sensation if applied to a tactually sensitive surface, and a sensation of colour if applied to the retina. What I feel is *the change*, and the nature of the feeling depends on the nature of the change produced. It is only if the transmutation reaches the sensorium that sensation is produced at all. However much it may affect any other portion of the organism, even of the nervous system, unless it extends to the particular portion of that system where the sensory afferent nerves originate no sensation is experienced, and when at length the process does reach the sensorial

centre it is only in the form of a change in its condition. A sensation cannot, therefore, be in itself a real thing.

Again, if a particular form of transmutation continues without intermission for a considerable period, the organ appears to adapt itself to the new condition; the very constancy of the change gives it the character of immutability, and sensibility simultaneously diminishes. In proportion as the change becomes an established condition so does the sensation disappear. (Carpenter, *Mental Physiology*, p. 138.)

The organism itself, as a living unit, is in like manner a constant process. In its normal operation that process does not involve sensation. It is the condition precedent to sensation. The organism is like a well-fitting garment. I do not feel it at all. Disturbances or interferences with the regularity of this process originate sensation, but the normal process is unfelt. Yet without the maintenance of this process life and sensation would cease to be. In reference to the organism, sensation is not merely consciousness of change; it is consciousness of changes in the normal process of change. To use a dynamical simile, it is only acceleration of the normal motion which is felt.

The most fixed and permanent of the objects of sense we are accustomed to call material bodies, and we are disposed to believe and affirm that they at any rate, or some of them, are comparatively immutable. If their form and condition vary, at

least their substance and quantity remain unchanged.

But matter itself is but a process. Its solidity and impenetrability are the phenomenal manifestations of the constant operation of what we are accustomed to call cohesive force. A force, however, is but a rate of transmutation. Let this dynamic process, so constant and invariable, cease to operate, and Solidity, Resistance, Body, Matter are no more.

Fundamentally the reality of matter is based on its indestructibility, on the fact that we cannot by any act of ours increase or diminish its quantity. But that just means that, however much we can alter the current of change in those transmutations which are superinduced upon the physical process in which materiality consists, we cannot affect or alter that process itself. We cannot alter the operation of cohesive force or of gravitation. Hence we cannot alter the constancy of the physical phenomena which depend upon their operation.

Some thinkers, whilst recognising the mutability of the sensible, have endeavoured, nevertheless, to extract or abstract from its data the primary permanent abiding features of the object world, and to find in these the main elements of reality. But the permanencies and constancies which they thus extract are but permanencies and constancies of change, and more than one critic has had no difficulty in showing that it is, therefore, vain to hope that we should be able to extract from, or discover

in the sensible, any element which is not in essence a mutation. The sensible world in one word is a process of change, and if we are ever to find the real and the immutable, we must transcend the limits of the world of sense.

II

THE AFFIRMATIVE JUDGMENT

THE foregoing considerations do not disturb the ordinary thoughts or actions of any human being. Every one of us grows up with the tacit assumption and belief that he is surrounded by a more or less permanent and independently real world which environs and contains the more or less permanent and real organism which he calls his body or himself. Sensations he regards as resulting from the action and as exhibiting the qualities and features of the objects of which the world is composed. Such beliefs are unaffected by the constant changes which the sensible environment obviously undergoes—unless, indeed, that they are rendered clearer and more definite by the contrast. This continuous practical belief in a permanent real world has lately received the not inappropriate name of the Affirmative Judgment of the waking consciousness.

This incessant affirmation of reality is an act of the mind. Whatever may cause or constitute the reality which sustains the world of sense, it is at least certain that *the affirmation* of reality is an

intellective act. Knowledge, in short, is a system of mental affirmations. Reality, as contrasted with the things of sense, themselves mutable and unreal, is erected for us by an intellectual operation.

What, then, exactly is it that we predicate in such mental act of affirmation?

We constantly affirm the continued existence, apart from sensation, of *things* in which qualities productive of sensation reside, which have causative efficacy, which resist our activity in definite forms whence we derive our conceptions of body and space. Perception, so called, is, in fact, a projection of these qualities, and our system of perceptual cognitions is a structure composed of such mental affirmations. Sense may be actual; but it is of something beyond and behind the actual that reality is affirmed; and such affirmation is altogether different from the mere identical proposition that sensation is felt.

The world, then, which surrounds us, and which we in the first instance describe as a presentation of sensation, is very imperfectly represented by such a view.

When I call the object in front of me a tree, I think into it a great deal more than what is given in sense. A strip of brown colour surmounted by some green is the total visual datum. In speaking of that as a tree, I not only think of the various changes which these sensations might undergo in consequence of my own actions; I think also of the tree as a thing—a potent dynamic entity asserting itself

as a permanent reality, and containing within itself powers of growth and change.[1]

In whatever I ultimately conceive that the reality of the tree consists, it is at least clear that I think of it as something altogether different from the immediate sensation to which it gives rise—that it is, in fact, not a sensible presentation, but a *thing*, the existence of which is the object of an assertion or affirmation by my mind.

When, therefore, I say that the affirmative judgment fills my world with things, I imply that for me the reality of the world around is something very different from the complex of sensible presentations whose undoubted actuality appears at first glance to constitute them, by their very immediacy, the most real constituents of experience. In order, therefore, to attain to clear ideas on this subject, it is evidently of first importance to distinguish between the affirmations of thought and the data of sense.

What really is the contribution of sense can be

[1] Dugald Stewart well illustrated the point upon which we insist by the consideration of what a book really is. "In looking at a page of print or of manuscript, we are apt to say that the ideas we acquire are received by the sense of sight, and we are scarcely conscious of a metaphor when we employ this language. On such occasions we seldom recollect that nothing is perceived by the eye but a multitude of black strokes drawn on white paper, and that it is our own acquired habits which communicate to these strokes the whole of that significance whereby they are distinguished from the unmeaning scrawls of an infant."

What we have to realise is that what is true of a book or other production of our own activity is similarly true also of Nature herself.

tested sometimes by finding what is wanting when the organ of sensation is absent. Thus the blind have no idea of colour but have of form; the deaf have no idea of sound yet have of musical form; and so on. In this way it will be found that the donation of sense is altogether meaningless without the datum of thought. But this test alone does not afford a complete distinction between Thought and Sense. We must trace the intellective datum to its source. The idea of *form*, for example, possessed by the blind is evidently supplied by their activity—not evolved by thought from some inner consciousness. And this suggests what we shall find to be the true basis of all cognition, from the simplest perception to the most perfect Science.

Science is said to be an expression of the laws of Nature. But what are laws? They are principles or forms of action. A law describes or prescribes a process, a course of action. If Nature were a mere stationary object it would be subject to no law. Law is universal and abstract, and is constantly distinguished from the sensible, the particular, the concrete. And herein lies the true secret of its universality. The law expresses the form of action irrespective of the where and when. Time and place merely mark the occasions of its interruption. They are the determinants of the actual.

Do not let the meaning of this statement be misunderstood. No doubt the *effect* of a natural law varies with particular circumstances. The height of the tides is different when the moon is new and

when she is full. Indeed, periodicity is a character of natural law, but the uniformity of the law is not thereby interfered with. The form of the law is independent of the fleeting state of sensation in which we discover it, and which we endeavour to rationalise in reference to our own life by spatial and temporal references. *Now, it is the action and not the sensation which is the object of knowledge.*

In its essential texture and constitution all my experience is an expression of the forms of action. Apart from action, there would be no such thing as form. These forms are not personal to me. They are common to all; and the most general of these forms constitute the features of spatial extensity—the subject-matter of geometry.

Extensity is usually regarded as the most fundamental feature of the object world; but extensity involves a visual element. To the blind, time ordinarily serves instead of space. When my intelligence is related to the world of pure touch alone, I estimate the magnitude of the resistance which sense discovers by direct reference to the duration of the exertions in which they are discovered. The periodicity of the animal functions, such as breathing, sleeping, etc., gives a primary standard for such temporal measurement. Vision, by presenting the main features, or at least the visual symbols of the main features, of my environment simultaneously enables me to compare and relate them contemporaneously.

And it is the same with all the elements of my

knowledge of the world around. It is not by merely experiencing or feeling sensations that I thus know and reason about phenomena; it is by associating phenomena together, and by referring them to the action of supposed potent agents or causes. It is thus that we erect the fabric of knowledge. It is in this that cognition consists. In the mental intellective act of affirmation I represent not sensation but the potent kinesis by which the sensible is determined.

III

THE NECESSARY POSTULATE

THE Affirmative Judgment is involuntary and inevitable. If it be possible in words to doubt the reality of the potent authors of sensible change, it is at least certain that we do not and we cannot for a moment act upon the truth of such a view.

Not only do we all constantly, involuntarily, and habitually affirm the existence of active and causative reality, of something real and permanent amidst the things of sense, but we cannot by any effort divest ourselves of the habit of such affirmation. Even Hume, indeed, admitted that he could not. The force of custom, by which he sought to explain it, was, he confessed, too strong for him. Bishop Berkeley invoked the immediate action of God as the perpetual supporter of the phenomenal world. Kant held that such affirmations were the necessary result of the constitution of the cognitive faculty itself. With modern agnostics Hume's explanation still holds the field. Yet it has been often shown that such explanation is inadequate. Custom, indeed, might no doubt lead us to expect the recurrence of

certain sensations in a certain order, and if such expectation expressed the whole of our belief and affirmation, such a solution might be sufficient. But our belief includes far more than this; nay, it is radically different from any mere expectation of this sort. Not only do I believe that when I make the necessary movements and look in the necessary direction I will again see the sun shining, the river running, and the tree standing where it stood. I believe further that these appearances are due to, are caused by, and are significant of the agency and operation of some potent reality which exists and persists altogether independently of my consciousness or sensibility. In attributing the origin of these beliefs to *our own* custom or habit, we are *necessarily contradicting* the most deep seated and permanent of these beliefs themselves. Neutrality or agnosticism is no proper name for such a view. All agree that these affirmations or inferences are inevitable, that our every act assumes their truth. And a philosophy which obliges us to deny that proposition or to affirm that such necessity is fictitious is *not* a position of mere neutrality.

Indeed a belief in the independent reality of the potent causes of sensible change seems to be involved in the very recognition of the fact that the sensible world is mutation. Change implies that which changes. If the sensible consists in transmutation, there *must* be something which is transmuted.

The objects of this affirmation are the ingredients

of knowledge. Without them knowledge would be impossible; speech and language would have no meaning.

Not only all science but common knowledge is found on examination to be a conception of things causally related—an explanation of sensible appearance in terms of *power*. The familiar reference to the faculty of perception as the source of our notion of outness or otherness is really found upon analysis to be a reference to potency.

The things whose reality we thus postulate and affirm are conceived as the potent and permanent sustainers of the sensible world. We frequently and, indeed, perhaps inevitably conceive them as themselves qualified by those sensible features which characterise the presentation of sense. But such sensible qualities are but the effect upon our consciousness of the operation of the power which sustains the transmutation in which they consist. The real postulate is fundamentally POWER. Obviously, therefore, there is no philosophic warrant for the belief that the sensation *resembles* that which causes it, or that *the thing which changes* can be truly conceived in the likeness of the change. "For as all works do show forth the power and skill of the workman and not his image, so is it of the works of God, which do show the omnipotency and wisdom of the Maker, but not His image" (Bacon, *Advancement of Learning*, bk. ii.).

Many there are who, recognising this, still seek an intellective explanation of necessity and univer-

sality. "All that you tell us," they say, "may be granted, yet the fact remains that the things affirmed are the creatures of the affirming mind, that beyond its limits any real substratum is unknowable, that we admittedly cannot transcend the datum of our own experience. It follows, therefore, that the only possible explanation of the belief in reality is subjective: either the mind in some way cognises sensible objects under certain forms or categories, and invests, therefore, the whole of our sensible experience with the forms by which its apprehension is necessarily conditioned and determined; or else Reality is but a name for that in the environment which responds to the needs of the individual." Such explanations in one form or another have been popular in recent years. Cautiously, as they think, abandoning the apparently futile effort to discover the real which underlies the sensible, prudently heedful of the warning afforded by the many failures of the past, and yet unable to rest satisfied with a purely negative scepticism, these thinkers, with a dangerous affectation of wise restraint, seek an explanation derived from the form of the cognitive apparatus, or the requirements of the appetitive impulse, and seem remarkably well pleased with themselves for doing so. But these, no less than other and more candid forms of agnosticism, involve a contradiction, not an explanation of the affirmative judgment. They mean, if they mean anything, that that affirmative judgment is an error. There may be a cause of it or an explanation of it

and that cause or explanation may have been discovered by these investigators. But if so, and if the cause and explanation are what they allege, then at least it follows that the affirmative judgment which *we*, nevertheless, and which *they*, nevertheless, persistently and constantly maintain affirms what is not really true. What we require, however, is not a futile attempt, however ingenious, to explain away the inevitable, but a rational account, not only of its genesis and its meaning, but of its inevitability too.

IV

ACTIVITY

SENSATION, then, is mutation; the sensible world is a process; the changes which occur in sensible and tangible objects are what we call motions; and the potent causes or operative agencies which we believe to sustain the sensible are conceived and postulated by the mind. But we require to be informed how the mind attains to a consciousness of the Potent and the Real. Now, in all the various phenomena of motion we recognise a fundamental distinction between putting in motion and being moved. Experience does not consist solely of sensation. Amidst my sensible experience I act, I move, I put objects in motion. In and by my actions I contribute to, partake in, and mingle with that kinetic process in which the sensible world seems to consist. My activity is incessant and continuous from the very beginning of conscious life, and contributes largely to the motions of the sensible environment.

In considering the fact of movement we must keep in view the necessary implications of the idea. Movement implies that which (using the word without reference to causation) moves. The neces-

sities of thought, perhaps, require nothing more, but my actual experience discovers in movement the cardinal distinction everywhere valid between that which moves or puts in motion and that which is moved—in short, the grand distinction between the active and the passive.[1]

The origin of this cardinal distinction is to be found in my own motor activity. My earliest consciousness recognises a constant connection between my action and the resulting changes in the sensible presentation. The idea of volition is a later product of abstraction. But my constant motor activity is one of the earliest data of consciousness; and the constant connection which that activity maintains with the surrounding world of sense is the first and most continuously operative element in my experience. The results of that activity may be sensations or sensible changes; its accompaniments may be the same; but action itself is not sensation and in no way resembles it. From the fact of thought Descartes inferred the reality of the thinker: *Cogito, ergo*

[1] It may at first seem strange that language should not more accurately record the fundamental distinction between moving and putting in motion. I say I move—I move the chair. The ball moves or is moving. But language is really accurate. When I say I move, I mean I put my body in motion; when I say I move the chair, I mean I put the chair in motion; when I say the ball moves, I unconsciously record the recognition of the fact that kinetic energy has been imparted to the ball, in virtue of which it really moves itself as much as I do my body. When, as in the case of the chair, the object has probably no kinetic energy, the appropriate and usual expression is, "The chair is moved."

sum; but far earlier comes the inevitable inference from action to actor: *ago, ergo possum.*

It is thence that I derive my idea of Power. My activity involves Effort.[1] I am surrounded, not merely by a sensible presentation but by an environing opponent, and the constantly opposing powers by which I am encompassed provide a standard for the measurement of my efforts. My power or capacity for effecting sensible change is in terms of its results a measurable and quantifiable thing. Its existence is not a datum of sense. It is a postulate, an immediate inference which I am compelled to draw from the observed facts of my experience—in other words, from the sensible changes which I can and do effect. Such an inference I habitually and incessantly make, and IN MY ACTIVITY THERE IS THUS SUGGESTED TO ME A SOURCE OF PHENOMENA FROM BEYOND THESE PHENOMENA THEMSELVES. Out of this original inference there grows up my belief in the *solidity of matter*; that is at bottom a recognition of the inertia or power of resistance which the environment offers to my exertional activity. Or, again, if indestructibility be regarded as the essential feature, that means no more than indestructibility by any effort of my activity. My power, in virtue of which I can effect changes in the phenomenal world, is a quantifiable and so far measurable thing, consumed by use and replenished by rest and food; but when so consumed, not thereby destroyed but still represented by its results. Measurability is required to enable us

[1] See note on p. 85.

to affirm indestructibility, and the knowledge of indestructibility is, therefore, conversely limited by measurability.

Every one ordinarily and involuntarily believes in real existence, and distinguishes between the real or self-existent and the unreal or merely apparent. We believe that the world is sustained by something which exists independently of our feeling or perception. But such a conviction could never arise from a mere passive condition of receptivity to sensation. The mere passage of a sensible presentation over a purely inert consciousness could never suggest the ideas of action or power. If the totality of experience consisted in a mere stream of such sensible presentations, causation would never have been suggested to the mind. There would have been no need to seek, no thought of seeking, for a real cause of phenomena. There would, indeed, have been nothing to suggest either the existence or the possibility of the existence of anything other than the passive presentation itself. Such a suggestion is derived from the fact of my potent activity, and from that alone.

My activity *presupposes* my organism, and *consists* in the production of motions therein and thereof. Hence the primary and unassailable conviction I feel in the so-called reality of Matter. It is vain to question the existence of that conviction. It is, however, quite another matter to analyse and explain it. That is what it greatly needs and what it is our object to attempt.

My activity then originates as an automatic and reflex organic function, and even in its earliest stage *it determines the form of my experience.* By it I am involved in the stresses which result from my action amidst the limiting environment, and thus on the analogy of the results of my own activity I involuntarily postulate other similar powers—the authors of all the other changes which occur within the world of sense.

Experience, then, is something very different from a mere succession of sensible impressions. Its fundamental constituent is my own exertional activity. This activity determines the elementary and essential forms of my experience, and the various panorama of sensation with which it is filled arises in the obstructions and interruptions which my activity encounters.

It is thence that the affirmative process of Thought is supplied with the elements, by the aid of which it builds up our conception of the world in which we live.

How then does Thought apprehend and become the conscious possessor of these facts of our activity? Is Activity a primary *cognition*, an intuition? Descartes held the fact of Thought to be an immediate cognition from which by inference the notion of the cogitant ego was derived. The *fact* of exertion is as immediately given in experience and is even temporally prior to that of thought; and the *potent Ego* is the corresponding inference. But how does the process of Discourse take up and

cognise the concurrent process of Exertion? It seems strangely difficult to determine how I come to know the fundamental fact of my own activity. Is it an immediate datum, or is it an inference from the sensible experiences of motional change? Do I perceive immediately that virtue has gone out of me, or is the knowledge derived from the results? To some extent the answer depends merely on the meaning of the words inference and intuition. In its essential nature the process of discourse, like that of exertion, is a development of potency into actuality. Even intuition, therefore, must be the apprehension or affirmation of one evolutionary process by another. But such apprehension may be immediate, not inferential. It would seem, indeed, that there must be intuition of activity, for the simple reason that there is nothing more immediate from which the idea can be derived.

But such intuition, even if theoretically possible, would in itself be altogether wanting in form and definition. It is by the obstructions which the expression of our noematical activity encounters—by the sounds, in short, which are the sensible results of such obstruction—that form, feature, and definition are supplied to the activity of Discourse. In a word, apart from Language, the process of Discourse would be incognisant of its own operation. And in like manner it is by and in the obstructions of my exertional activity that its forms are defined. Sensation seems to be the medium by which both Discourse and Exertion are rendered knowable.

There is no doubt that my actions are commonly and most readily presented to consciousness by their results. These results are neither more nor less than motional changes amidst the resistant objects of Sense. Putting objects in motion or altering their state of motion or apparent rest are the sole or chief results of my actions. I am very apt, therefore, to regard my activity as merely an element in the phenomenal world which we have already found to be a mere process of change.

The contribution of my activity to the fabric of knowledge has, therefore, been very much overlooked, if not ignored, by the builders of theories and the framers of systems. But it is never for a moment overlooked or underestimated by those unconscious philosophers whom we call Understanding, Reason, and Language. The affirmative judgment of the waking consciousness is the perpetual assertion of the potent activity by which the sensible is sustained.

It is, then, by inference from the facts of action and its obstructions that I gradually develop the ideas of self and other potent agents, causes, or things. The process of recognition is gradual and instinctive. The activity of my own potent organism and the activity of my environment are from the first intermingled, and it is in the conflict that the idea of myself as an actor is evolved.

My belief in potent agents or actors as the authors of the sensible experience which environs me is, then, of the nature of an inference from the data

of sensible change. To this extent the affirmative judgment is derivative. Of course the knowledge of my own agency seems more immediate than that of any other. It is on the analogy of such activity that I learn to postulate and infer the agency and operation of other real and potent agents sustaining and causative of the sensible world. Both, however, are interrelated inferences from the fact of activity and its obstructions.

But if the existence of real agents is an inference it is logically questionable. It may in words be doubted. It requires a mental act which, theoretically at any rate, I may decline to perform. If such declinature were really possible, we might in the end be obliged to conclude that the inference is erroneous—that beyond the sensible presentation there is nothing else; that, as Hume supposed, and as some modern agnostics have maintained, the panorama of sensible change is the only indubitable fact. We cannot really act on such a view of Experience. But whilst, in fact, the reality of the Potent is unquestionable, in the domain of speculation such doubts have been the burden of metaphysical discussion since the days of Heracleitus.

After more than two thousand years of philosophical inquiry, we still to-day find thinkers who profess them, who will say that at the best the inference is the result of custom and has no certain warrant of truth. Indeed, a very fashionable form of Eclecticism has recently been that which proposes to accept the reality of the given—of experience as

it is. Such a position means nothing and settles nothing. We all start and must start with experience, and must accept its *actuality*. But this does not necessarily explain to us its *reality*. And it is just that further interpretation of experience, undertaken with a view to distinguish the real amidst the actual, which constitutes the task of Metaphysics.

The question of how the affirmative judgment arises, what is its warrant and its real meaning, has been the primary quæsitum of human speculation. It is the problem of the nature of Knowledge. We have sketched in outline the answer which we suggest for its solution. We shall now briefly review the history of the inquiry in order to see somewhat more clearly how such an answer should help to solve the difficulties and remove the continuous contradictions which have perplexed speculation.

We shall then shortly indicate the support which such an answer receives from the conclusions of Physical Science and the light which, in return, it is calculated to shed on various departments of Intellectual Inquiry.

V

THE ORIGINS OF METAPHYSIC

It was in the discovery of the distinction between thought and sense, between the noumenal and the phenomenal elements in experience, that the problem of knowledge arose. It is in the due appreciation of this distinction that its solution will be accomplished.

To the Greeks we owe the grand discovery. Other thinkers may have discussed other important problems. This we owe to them.

The Eleatics first became conscious of the distinction expressed in the terms—*φαινόμενα, νοήματα, δόξα, ἐπιστήμη*.

Parmenides is credited with the doctrine that reality is unitary and metaphysical, and he is usually regarded as presenting a view directly contrary to that of Heracleitus,—that all is mutation. But, indeed, they should rather be regarded as complementary. The mutability of the actual, of the sensible, is at least not inconsistent with the unity and immutability of the real, and might almost seem to imply it. The unity and eternity

of the Κόσμος is, indeed, affirmed by Heracleitus, who also in some passages expressly limits the affirmation of mutability to the things of sense.

Notwithstanding the subtlety of these thinkers, a marked advance must be attributed to Socrates. He it was who awakened in man the idea of science —of knowledge properly so called—and for the first time clearly contrasted it with sensation.

Hitherto speculation had been engrossed with the question of what was the nature of the world and what were the elements of which it was composed. Socrates gave a new meaning and direction to the inquiry by reminding man that the problem primarily concerned his own faculty of apprehension.

What did he really mean ?

We all understand and recognise, and no doubt many Greeks before Socrates had recognised, the fact that we think ; that we meditate upon things ; that we consider about things ; that speech is an expression of such thought, and that thought is very different from what we call feeling. So long as we regard the process of thought as a separate and independent mental activity detached from our perception of the sensible world which surrounds us, this is quite obvious. No doubt Socrates recognised this contrast. But merely to do that would not have been of first importance. There was no new —at least no influential—discovery there.

What Socrates did was something other than this. He referred not to the knowledge, if any, which we acquire in virtue of the detached and, so to say, in-

dependent activity of thought, but to the knowledge which derives its constituents from the world of our external experience. We may admit, perhaps, that he rather overlooked the distinction between the affirmations which are not founded on exertional activity and those which are. Truth, virtue, redness, hardness he seemed to group together indiscriminately as ideas. But at any rate he affirmed that *all* knowledge properly so called is an intellective process, not a product of feeling or sensation. The ordinary person thinks that knowledge, at least of the external world—and that is the fundamental part of knowledge — is the donation of sense. Socrates affirmed the epoch-making, and seldom appreciated proposition that it is no such thing; that, on the contrary, it is the structure of thought, of intellective activity.

All might agree that cognitions which express the mind's own operations are intellective. The doctrine of Socrates affirms that the science of the outer world of sense is intellective also. In order, therefore, to attain to a true understanding of what the world is, we must first investigate the nature of our own faculty of cognition.

When we speak of a straight line, a circle, or an angle, the idea so expressed is quite different from the feeling or sensation involved in the visual presentation associated with these names. Any one of those visual impressions is simply a condition of consciousness, in which or from which we can find or extract a single instance or example of the

common notion or idea which we name straight line, circle, angle. The idea is very different from its sensible instance. The distinction is sometimes expressed as that between the form and the matter; but even that statement does not convey its full significance. At least, if by the form of a thing is meant merely its outline in visual extensity, the doctrine of Socrates is very imperfectly represented by such a statement. The concept or idea of a thing with him included its whole essential nature; its qualities; all of it that was cognisable. In fact, it was of qualities only that Ideas were possible. Nor was this view of knowledge limited to geometrical figures. Our cognitions of such figures admit of an ideal perfection which is not attainable in our cognitions of sensible qualities generally. The form of a geometrical figure seems certainly to constitute its essence. In the case of such figures the doctrine of Socrates appears, therefore, not only readily intelligible but, perhaps for that very reason, readily credible.

But the principle as enunciated by Socrates was not so limited. It applied to Knowledge of all sorts—of all the various objects which constitute our external environment, not less than of the moral qualities and metaphysical notions which are the furniture of reflective thought. Knowledge in every case and always consisted of general concepts or ideas, and was concerned wholly with these. Sensation *per se* was altogether excluded as a constituent of cognition.

The doctrines of Socrates being gathered entirely from the writings of his disciples, it has always been difficult to determine exactly what and how much was the proper theory of the master, and what and how much was the supplement of the disciple. The form in which the Platonic dialogues convey their teaching, and the doubt which prevails as to the chronological order of their composition, greatly increase the difficulty of such a determination. But it is perhaps of little moment.

The fundamental distinction between Thought and Feeling, between the intelligible and the sensible, between the law and the fact, between the noumenal and the phenomenal, was clearly laid by Socrates, and has ever since remained the real basis of Metaphysics.

Undoubtedly the doctrine was imperfect and inconclusive.

That knowledge cannot consist in sensation has indeed been readily accepted by most of those who have reflected on the problem at all. For not only is sensation fluent and unstable, but it seems to contain or be supported by no sort of guarantee or assurance of any identity common to two or more intelligences. Our measurements of sensibles always require and involve comparison with an intermediate standard. To take the very simplest sensation, I cannot tell if blue is blue to another. How can I tell if the sensation is the same to both of us? The consideration of this simple question at once suggests that when I refer to the mere sensation

the question is really meaningless. I see at once that it cannot be answered. At the same time it suggests that the subject of discourse is something else than the sensation, namely, the quality or idea of blue—which somehow or other *can* become the common property of more than one Intelligence.

But Socrates did not tell us by what gateway other than sensation these common qualities of the Real world make their entrance into the individual mind, nor how the community of Knowledge is established amongst men.

It is the sensible world with which, at least in the main, our concepts or ideas are concerned. How, then, can we attain to an adequate or accurate knowledge of that world by a process of thought from which the sensible is entirely excluded? How can Knowledge represent to us a system of things the most conspicuous element of which is entirely excluded from its apprehension? What sort of thing can this system of cognition be? What exactly are those cognisable elements of the sensible world which the faculty of Knowledge extracts from the texture of the presentation, and which are said to constitute and to be known to constitute the essential elements of Experience?

These and such as these, reappearing in a thousand forms, are the difficulties with which the theory of Human Knowledge has been constantly confronted ever since its foundation was laid so long ago in Athens, and to answer which has been the main task of speculation ever since.

VI

REALISM

IN the hands of Socrates the theory of Cognition, although it proclaimed to mankind a new principle of the very first importance both in its nature and in its results, was still imperfect. He appears to have confined himself to the investigation of the cognitive faculty. "Know thyself" was his constant and all-sufficing maxim. It remained to be seen how the faculty of knowledge as he had described and defined it was able to apprehend and represent to itself the multifarious facts and laws of the environing world. One might admit the Socratic view of the noematical or ideal character of knowledge, and still fail to see how we could tell that it had its counterpart in Nature. It was open to his disciples to affirm that the fabric of knowledge is a product of our mental activity, and yet feel obliged still to hold that Cognition of the external as a representative process must be regarded as reproducing—systematically it may be, still also mimetically or pictorially the sensible features of experience as discovered in perception.

It might be maintained, in short, that the formal element in knowledge was merely a systematic apprehension of *the relations* of sensible phenomena. By perception is meant the faculty by which our sensations are apprehended as presented in an orderly arrangement external to ourselves and definitely related to one another and to the things with which we associate them. That knowledge represents this arrangement might be granted, and still it might be maintained that it *must also* include and, indeed, *must be based* on a mimetic representation of sensations if it is effectively to express our whole actual experience of the external world.

There was thus an obvious difficulty in the way of the Socratic theory of Knowledge. If knowledge is representative of sensible experience, it would seem that it must itself be, or at least must include, a reproduction of sensible data,—that it must not, or at least must not exclusively, be an intellective system. If so, we are back where we were before Socrates spoke.

This difficulty evidently weighed profoundly upon the mind of Plato. Socrates had not gone far enough. The independence and ideality of knowledge were still unsecured. Plato, therefore, made a further and supremely momentous advance. He took the step which led him to say that knowledge is not an independent reproduction of the constituents of the perceptive act. The perceptive act is itself knowledge. The concept is the essence of the precept. In short, he affirmed in the world

of things an ideality correspondent to that which Socrates had shown to be constituent of knowledge. Intellectual notions or ideas, whilst they compose the elements of knowledge, are also, so he affirms, the essential constituents of the real world of Experience. At any rate the real elements of experience are exact counterparts of the ideal constituents of Cognition. Although Plato called the forms of real things Ideas, and although his language often seems to imply that Reality is to be *identified* with the Idea, he did not, in fact, mean to imply that Reality *is* the creation of Thought. In his anxiety to emphasise the principle of his doctrine he sometimes uses words susceptible of such a misleading inference, but it is clear from his most mature writings that what he really meant and struggled to convey was that the real and essential character of things was their form or Idea (*ἰδέα*), an element homogeneous with that which constituted the essence of Knowledge, *εἶδος*;—that it was thus that knowledge was able to cognise and to represent truly the essential characters of the real world. Sensation he regarded as a purely subjective state not only fluent and unstable, but as consisting in mutation, not itself a thing possessed of existence at all; the objective entities constituent of the world being the ideal forms of things which were or could be reproduced or represented in Cognition.

According to Plato, then, the whole fabric of experience is in character intellective. The notional

products of our Intellective activity he had designated ideas—εἴδη. Ideas with Plato, as with Kant and with all thinkers worthy of the name, are not faint pictures of sensations,—of colours, sounds, and the like. Such, in truth, constitute an absolutely insignificant ingredient of our mental furniture. Ideas are the instruments of intellective *activity*, the forms of the *act* of cognition. And that being so, Plato boldly maintained not only that real knowledge consists in and is composed solely of Ideas, but that such ideas, or their objective counterparts, constitute also the very essence—the significant qualities—of reality.

Schopenhauer has said that Realism may be stated thus: "When we observe that all those *actual things* of which alone reality can be predicated are temporal and consequently pass away, while the qualities such as red, hard, soft, life, plant, man, horse, which these names signify, continue to exist independently, and consequently are always there, we find that the qualities which these names designate by means of common conceptions are conceived through their indestructible existence, and therefore have reality, which is consequently to be attributed to the conception and not to the particular being."

Plato, in developing his doctrine, went quite as far as is implied in the statement just quoted. The enduring qualities of things were for him essentially ideal and quite to be contrasted with the sensations which accompany and reveal them. Thought and

existence might be distinct, but they were in quality identical, and it was thus that we were able in thought truly to reproduce and represent the character of the real. So far so good. It might seem as if thus at last we had arrived not only at the true nature of knowledge but at the true essentials of Reality, and had made it clear how cognition of the external was accomplished. But Plato still failed to tell us what was to be done with the sensations. These might be, as he truly showed, mutation merely and unreal, yet they were ever with us. If we could not know that they existed we knew that they occurred. However incapable of being the objects of real knowledge, they still seemed to demand that they should be accounted for. This, however, was what Plato failed to do, or at least to express his explanation in a form available to be apprehended by others. He failed to isolate in thought the potent motive Energy of the Real World. He failed to understand that Thought and Thing are both activities. Awarding by his theory no place to the independent potency of Nature, to the δύναμις which, by its constant transmutation into actuality, determines, nay, constitutes, the world of sense, he was unable to suggest any explanation of how the sensible arose in experience or what relation it truly held to the pure and formal Reality. Accordingly he could make no distinction between the abstract Ideas constructed by or representative of our purely mental activity—the products of moral

sentiments and the like, and those abstract ideas which are founded on a perception. By a species of philosophical trans-substantiation he set up a qualitative unity between the ideal and the external, but he failed to show wherein the pure notion differs from a cognition founded on Experience.

Every assertion implies the use of a pure idea. The statement, "That is the letter 'A,'" has no meaning unless the idea of that letter is already in the mind, and is thus available to be employed as an instrument of discourse whenever the sensible phenomenon may suggest it. And in like manner, on the other hand, every single feature or quality which constitutes an element, great or small, in our experience, along with its sensible characters, has at the same time its substantial, or as we prefer to say its dynamic, form, in virtue of which it is capable of representation by the ideative activity of Thought—is, in short, in essence or quality conceptual, intelligible, ideal. These two aspects of a thing are related or combined like flame and heat. Such dynamic forms are available to be constantly apprehended by thought as the interpreters, the sustainers, the real constituents of our experience of the world. In such apprehension Plato held that knowledge consists, but he failed to discover its dynamic origin.

Ideas, therefore, with Plato were both general and abstract: general, because as the constant furniture of knowledge they are applicable indifferently to

every sensible instance in which they are expressed; abstract, because they express the pure forms of thought apart from the accompaniment of sensation.

It was to ideas thus conceived that he awarded a true participation in the real world. The form of every object, the notion by which we think of it and to which we conceive that it seeks to attain, is with him, ideal; but, as already mentioned, this principle afforded no ground for any distinction between the most abstract of moral conceptions and the most solid of material things.

The doctrine of Plato under the name of Realism for centuries dominated Philosophy, and is often claimed as the parent or precursor of modern Idealism—to use the somewhat misleading name generally adopted by those who, starting from a basis fundamentally the same as his, go on to affirm that Reality is not only in essence identical with knowledge, but, in fact, owes its existence to the affirmation of the Mind.

Such theories in identifying knowledge and Reality deny altogether the representative character of knowledge. They do not so readily admit or appreciate the fact that they at the same time necessarily deny the truth of our inevitable belief in the independent reality of our Experience. But if to be real does not mean to exist independently either of Cognition or of Sensation, and is not contrasted with mutation as discovered in sense, then it has no meaning. At any rate all such theories are, and have always been, confronted by the

difficulty which confronted Socrates and Plato—the difficulty, namely, that they leave unaccounted for the occurrence of the sensible presentation.

If Knowledge is an intellective process, its ideas cannot constitute the particulars of our sensible experience. On the contrary, the distinction between Thought and Sense directly arises upon the formation of the Socratic theory of Knowledge.

The relations of the sensible, the forms of the real world, may be apprehended by thought, but how does that account for the veritable appearance of the actuality of sense? How does the latter connect itself with the real forms? Does it inhere in them, arise out of them, or overspread them? How are they related? Is there any common ground?

Materiality, the hardness and fastness of the real world, have often seemed to afford the wished-for nexus. But then these seem to be reducible to sensible qualities, and all sensible qualities being, as we have seen, mutation, it follows that they cannot lead us up to reality. Whatever their value as unifying concepts, materiality and hardness and fastness, therefore, must be abandoned as mediators between sense and Reality.

The sensible must be accounted for. It was here, we repeat, that Platonism failed. It left sensation an undoubted, but also an unexplained and unintelligible, fact. Deprived of all light on this most urgent problem, it was compelled to rest

satisfied with the consolation that the sensible, being unreal, must be regarded as unimportant, and sought comfort in the reflection that it had at any rate attained to knowledge of the truly Real.

VII

THE POTENTIAL AND THE ACTUAL

SUCH seems to have been the position of Plato. It failed to secure the acceptance of his pupil Aristotle.

Aristotle accepted the Socratic exposition of the nature of knowledge as a system of general concepts, the product of the mind's constructive activity, but he refused to admit that such concepts adequately explained either the actuality of sense or the reality of the world. He preferred the view that thought, being an affirmation, necessarily points to something other than itself, that affirmation requires both a subject and a predicate, and that the predicate could not be furnished by the mere fleeting sensation—in itself a transmutation only—but must contain within itself the explanation and the prepotency of every element of experience, of the entire fabric of environing Nature. The key to this he seems to have found in the very fact that the Sensible *is* mutability. Transmutation implies also that which is transmuted, or which can transmute itself. *That* in the transmutation

process which gives rise to sensation and so constitutes the actuality of sense must also exist potentially—*ἐν δυνάμει*—and thus furnish the real predicate of thought. The universal element in discourse was not, therefore, identical with the act of thought, but was latent somewhere in things themselves—*universalia in re.* In other words, whenever we speak of any physical thing, event, act, or operation, whenever the material world of our environment is the subject of our thought or speech, there is a simultaneous reference at once to the sensations which accompany them and to the real energetic operations out of which these sensations arise, in which they consist, by which they are sustained, and without which they cannot evolve into actuality.

Nature, Aristotle told us, is the vital activity of an ever-moving power—a constant energy for ever evolving new forms in virtue of its own potency. The potential is ceaselessly transmuting itself, and the kinesis in which the sensible consists is the constant result.

Men had confused the *actual* with the *real.* However unreal the sensible might be it was still actual, and must, therefore, be accounted for, and the explanation Aristotle found in this perpetual evolution of the potential; a process which it is the work of knowledge to apprehend, but not to constitute or create. The ideality of the world was to be found in the potential energy by which it was sustained and by which it became intelligible.

But although it was intelligible it was not, therefore, intellective. Nature herself supplied the ideally apprehended forms of which our knowledge seemed to consist. As Leibniz very truly says (*Metaph.* viii.), "Every true predication has some basis in the nature of things." Intelligence and the Intelligible world, notwithstanding their affinities, are neither identical nor coextensive. On the one hand, the intellectual world is more extensive than the Intelligible world. We possess many general ideas to which no substantial entity corresponds. But, on the other hand, it is equally true that the intelligible world is not only distinct from Intelligence, but is part of a much larger Whole. It is a mere fraction of the vast energies of Nature. It is only that fraction which, from its affinity with the Activity of Thought, is capable of representation in Cognition. Even within the organism there are regions of activity below, above, beyond the reach of cognitive apprehension. The sub-liminal self is an ocean in which the cognisable and the cognitive are each but a single island or an isolated current.

VIII

THE MIDDLE AGES

WHAT might have been the consequences to Philosophy had Greek thought sustained the speculative inquiry until Aristotle's profound conception had had time to be realised it is difficult to say. But it did not. In the establishment of the grand distinction between thought and feeling, between the noumenal and the phenomenal, between the universal and the particular, between the law and the fact, between the objects of reflection and the objects of sense, Greek thought gave birth to Philosophy. But it died in the effort; and the unnourished infant was left to struggle through the Dark Ages.

It is true that, in the then existing state of the knowledge of Nature, Aristotle's theory was involved in difficulties almost as great as those which enveloped Realism. If Plato failed to explain how the idea could be potential amidst the things of sense, Aristotle failed, perhaps equally, to show how, if it were excluded from such participation, it could ever become cognitive and affirmative of what was to it a foreign land, or rather an unstable

quicksand. And so throughout these Middle Ages it was Platonism that really held the field. Aristotle, no doubt, was the most studied teacher in the schools, but the Aristotle studied there was the Aristotle of the Logical Organon, of the formal exposition of the laws of thought itself—a subject to which the Platonic Realism had given its chief significance and import. Those treatises in which he had elaborated, in opposition to Plato, his metaphysic of the real world and set up his theory of the potential and the actual in contrast with the pure intellectualism of the Academy, were forbidden or at least unknown.

A provincial synod held at Paris in 1209 ordered that the Metaphysics which had recently been brought from Constantinople should be burned, and that no one should read them or keep them in his possession. Six years later a Roman legate dispatched by Innocent III ordered that the Dialectic or Organon of Aristotle should be read, but forbade the perusal of his metaphysical and physical writings. In 1231 a rescript of Gregory IX ordained that his works on Natural Philosophy should not be used till purified of error. In 1265 the regulations of Innocent III were confirmed by Clement IV (Barrington, *History of the Middle Ages*).

Thus throughout the Middle Ages men for centuries maintained their endeavour to construct the science of Nature by rational deduction from their own mental conceptions. In the very limited sphere of Logic and Geometry all went well. But when men extended this method to the knowledge

of natural law, operating beyond the limits of their own mental and motor activity, all was blank failure and disappointment. "For the wit and mind of man, if it work upon matter which is the contemplation of the creatures of God, worketh according to the stuff and is limited thereby, but if it work upon itself as the spider worketh his web, then it is endless, and brings forth indeed cobwebs of learning admirable for the fineness of the thread and work but of no substance or profit" (Bacon, *Advancement of Learning*, bk. i.).

Alchemy and Astrology were examples of the object, the method, and the achievement. Throughout the period of the scholastic discussions Realism, therefore, was supreme. And by Realism was meant the doctrine which more or less completely identified Reality with the conceptions of thought—a doctrine which, as we have seen, has in modern times been reasserted as Idealism.

It is generally said that the Scholastic period closed with the re-establishment of the principles of Nominalism, which, as opposed to Realism, affirmed the distinction between thoughts and things, and which, though called Nominalism as opposed to Realism, would in these days be very likely described as Realism in contradistinction to Idealism. At any rate, whilst Realism prevailed, so equally prevailed the doctrine which affirmed at least a qualitative identity between knowledge and reality, and endeavoured to draw from the necessities of thought the essential elements of the object world.

IX

THE RETURN TO NATURE

If the Idea is in quality identical with the essential elements of Reality, it is not unnatural to suppose that by rational deduction from the implications of Thought we should be able to deduce the laws and characters of the Real. This, therefore, was the method by which for so many centuries the study of Nature was pursued. But the result was barren.

It was in the protest against these methods that modern science arose. Convinced at last of the futility of attempting to attain to the knowledge of Nature by deduction from their own conceptions, men resolved with Bacon to return to Nature herself—to seek in the phenomenon, in the actuality of sense, the true if hidden principles of natural law. They had discovered that they could not derive the nature of things from the implications of Reason. They resolved of new to seek the key amidst things themselves. The establishment of the ever-growing system of modern natural science has been the triumphant result. Surely the protest has been

vindicated. Evidently there was something wrong in the medieval method.

The movement reflected itself upon Metaphysics. The implications of Reason had proved useless as instruments for extending our knowledge of Nature. Had they any value left at all? At any rate, was it not essential to review the matter from the very foundation? Descartes inaugurated the new spirit, and resolved to make a complete re-examination of all our mental conceptions and affirmations, and to ascertain afresh which, if any, were absolutely and necessarily true.

The reality of the process of Thought was not, indeed, at first denied. Descartes started with a "cogito." It was to the reality of the external world that his method was applied.

But the new habit of mind, which had led the physician to accept the actual and the sensible as the first and most immediate datum of natural knowledge, spread like a contagion to Metaphysics, till, with Berkeley and Hume, the presentation of sense obscured and overwhelmed its own ideal framework, and the very fact of thought, the very actuality of the reasoning and cognitive functions, was overlooked or forgotten. Ideas were regarded as merely faint reproductions of the things of sense. The entire content of consciousness was supposed to be supplied *ab extra* to the mind by sensation.

Those thinkers misapprehended fatally in what the new method of Science consisted. Science had turned to Nature, to the external, to the sensible,

to the phenomenal. But it was not to mere feeling or sensation that Science addressed her fruitful inquiries; it was to Nature as a potent dynamic operation. It was by acts of experiment, eliminating the forms of natural action, and by representative observation of natural processes, that Science conducted her inquiries and ascertained their laws and forms. In short, Science is throughout a study not of sensation but of Power in action, of which sensations merely indicate the fluctuations. And it is to this fact that we must attribute its effective extension.

X

SENSATIONALISM AND INTELLECTUALISM

THE failure to deduce the Science of Nature from the implications of Thought had thrown men back upon the external and the sensible, and in this position they not only overlooked the fact that it is still thought which *apprehends* the relations of the phenomenal world, but entirely forgot also that it is only as the signals of the potent kinesis in which Nature consists that sensations possess any meaning. So disappointed were they with the results of the medieval effort that they inclined to deny the reality of intellection altogether, and to repudiate its office not only as constitutive, but even as representative of the dynamic process of reality.

Thus it was partly with Locke and wholly with Berkeley and Hume. Reverting with a rush to the sensible as the key to knowledge, they regarded the idea as a mere faint reproduction of sensation, and, disregarding altogether the activity of the affirmative judgment, they looked upon the sensible presentation as a stream flowing over a passively

recipient consciousness. Ideas were but the images by which sensations were reflected in the silent mirror of the mind. They altogether overlooked—probably because they did not understand it—the Aristotelian principle that the sensible was the mutation of a potent, ever kinetic energy, capable of presentation in knowledge because, and only because, both Knowledge and Reality were activities of correspondent character although separate and distinct.

Berkeley's ardent spirit seems to have led him to embark upon philosophic inquiry without having first really taken sufficient pains to understand the meaning of the Socratic theory of knowledge. This defect tainted all the efforts of his splendid genius, although in his later writings he seemed to feel himself obliged to restore to Philosophy under the vague name of notion what he had refused to recognise as idea. The result was the development of a school of thought by which experience was reduced to a mere stream of impressions beyond which we could not penetrate—a conclusion which really made knowledge impossible and truth unattainable. It was a conclusion, moreover, upon which no man could act. That fact alone should have made it at once evident that it did not supply a satisfactory solution of the problem of knowledge or a satisfactory explanation of experience. Hume, indeed, admitted that custom or habit constrained him to affirm realities not given in sense, but he held that the affirmation had no other basis of

validity. Beyond the actuality of the impression he found no reason for affirming the existence of any subjacent reality. The logical consequence of such a position should have been the abandonment of the vicious habit. This being impossible, the disciple of Hume is left in a position of hopeless inconsistency, for his theoretical conclusion requires the denial of postulates *which he finds it impossible*, for a single moment, even *to doubt*.

Of course a position so reactionary involved and invited protests.

Reid's disclaimer in the name of common sense, irresistible in its cogent honesty, was, however, a mere reassertion of the affirmative judgment, and offered no solution of the difficulties in which speculation had become involved.

But the scepticism of the time led also directly to the more formidable protest of Kant.

Kant sought to restore Philosophy by again deriving from the constitution of the cognitive faculty the permanent relations and enduring features of the object world. Avoiding the weakness of seeming to project ideas amidst the things of sense—a weakness which might have been charged against Plato—he sought to sustain and co-ordinate the mass of sensible phenomena by an articulated fabric of mentally generated categories.

So far as the formal constituents of knowledge were concerned—the principles of enumeration and the laws of space—the truth of Realism had never been shaken. It was when men sought to penetrate

farther into Nature's secrets that its method had failed and that observation had been found effective. Did Kant really help us ?

He formulated a scheme of cognition under which the validity of knowledge was explained in terms of the categories of space and time imposed on the faculty of sensible intuition, and of the categories of the understanding by which were furnished the necessary implications of the reasoning process. The laws of Nature were to be deduced from the observation of phenomena and were supposed to be thus accounted for. The phenomena themselves remained as an inexplicable and irreducible residuum. Now, however clearly the laws of Nature may be distinguished from the principles of enumeration and of spatial form by their want of *a priori* certitude, yet they are not gathered and apprehended by mere passive receptivity. The whole science of Nature is an intellective investigation of causes. As Science advances to perfection it increases also in ideality. But along with such ideality is carried the concurrent affirmation of reality. The laws of Nature are cognised as objectively valid and as forming the inherent and self-existent texture of the real world.

Kant's metaphysic involves a surrender of this feature of scientific cognition. Although he recognised that knowledge of Reality required and demanded some objective basis, which he endeavoured to find supplied in intuition, he must still be held to have admitted that knowledge of the

external, properly so called, is unattainable. What is an intuition? The term seems to be derived from a misleading analogy between Vision and Thought. If, indeed, Vision be conceived as an activity, the error can hardly arise. But Vision being commonly regarded as a passive state, men erroneously conceive the mind in like manner to be the passive recipient of propositions self-evidently true. But all such propositions are really assertions which the mind necessarily makes in virtue of and in obedience to the laws of our organic constitution. They express the forms of the process in which our Activity partakes. Intuition somehow has reference to the apprehension by our noematical activity of the facts and forms of our exertional activity. This, the essential nature of Intuition, was overlooked by Kant. According to his view, apart from what is supplied by the categories, no real knowledge can exist. The mind is really limited by its own forms, which are imposed upon the indefinite datum of sensation and thus convert feeling into knowledge. Knowledge, therefore, *ex hypothesi*, is limited to the self-erected structure of Intelligence filled in by the unknowable phenomenon. Such a view, though less obviously than the scepticism of Hume, is, in fact, quite as completely a denial of cognisable reality and a contradiction of the postulate which the affirmative judgment incessantly predicates. It has inevitably led to the evolution of that school of German thought which more and more completely has

gravitated towards a pure monism, to those theories which hold the reality of the external world to be an affirmation of the Mind.

More systematic than Plato's, Kant's explanation of our beliefs was essentially a monistic elaboration of the principles taught in the Academy, and notwithstanding the vigour with which the movement has been sustained and the assurance of its votaries, it is nevertheless evident that it is now about to exhaust itself without solving the problem of knowledge.

If, indeed, knowledge, being intercepted by its own forms, never really reaches reality, how could the result be otherwise? It is allowed, nay alleged, that the world of knowledge is the creature of that knowledge itself. We cannot, therefore, get out of ourselves. The forms of the cognitive faculty may systematise into science the illiquid datum of feeling, but the real thing in itself can never thus be reached. Nor can such a theory in any way explain how the sensible datum arises and makes its way into consciousness.

It is equally evident on mature consideration that the assumption of spatial tridimensionality as a primary datum of knowledge is without logical warrant. In postulating the categories of space and time as original *a priori* elements of his mental furniture, Kant really borrowed from Nature, and started off on his investigations with a complex datum which he never attempted to explain or to reduce to simpler elements, nor even to account

in any way for its presence in the changing texture of cognition.

The futility of idealism is now begun to be realised. All attempts to identify knowledge and reality, to regard reality as in very truth created by an affirmation of the mind, are subject to two great and ultimately fatal objections—(1) they do not account for the presentation of sense which we inevitably regard as, if not real, at least actual, and as the surest guarantee of reality; (2) in robbing Reality of its independence of Cognition they rob it of its all.

On the other hand, all attempts to maintain a separation between knowledge and reality, and to regard knowledge as representative, have been vitiated by the supposition that such knowledge must be a mere reproduction of the sensible presentation, and seem, therefore, to involve a denial of the reality of what is known. Neither result is satisfactory.

But if, admitting knowledge to be representative, we regard it as an activity,—representative not of sensation but of the dynamic process by which sensation is sustained, and by the transmutation of which the sensible can be explained and accounted for,—it seems that thus at last we may find a solution which avoids both of these objections. Recognising that the organism of man comprises *two* great Activities, Thought and Exertion, we can find, independently of Cognition yet still given to us *a priori*, the necessary forms of Reality.

In one way or another the inevitable result of the idealist view is to identify the idea with the real, the concept with the conceptually apprehended entities which sustain the fabric of experience. All that can be urged against the realism which dominated speculation for two thousand years can be urged with equal force against this more extreme and one-sided extension of the same principle. Amplify it, elaborate it as you like, this central difficulty remains.

Schopenhauer felt the difficulty very strongly, and endeavoured to remove it by his doctrine of the Will-to-live as the ultimate reality in experience. But this vague postulate, though in principle true and significant, failed to furnish the necessary nexus by which the potential and the actual must be co-related if a representative theory is to be maintained. What we want is an explanation of how the principle of the Will-to-live evolves and develops the multifarious features of actuality. This cannot be done in terms either of intellectual activity or of any form of volition. The potency which sustains our experience must be conceived as something which participates in and out of which we can intelligibly evolve the sensible world. Philosophy is not a detached and self-continent inquiry. It demands the exercise of the most mature and highly cultivated intellectual effort. But the world with which it deals and which it seeks to explain is still, after all, the same actual, sensible, ever-present world of daily experience in

which we live and move and have our being. And unless and until we can definitely relate the postulate of our Philosophy with the infinite actualities of experience we have not arrived at truth.

XI

THE DEFECT OF REALISM AND IDEALISM

The doctrine of realism, whatever else it may have explained, failed to explain the appearance of the data of sense. The cognitive ideas of Plato, whilst they seem to express the forms, the relations, and all the essentials of reality, are impotent amongst the things of sense. How do they generate the actual, how originate or sustain the constant transmutation in which actuality consists? However unreal the sensible and the phenomenal may be, it is undoubtedly actual. Nay, it is their constant association with the actual and the sensible which fundamentally distinguishes real things from ideals. A reason for this is just what Platonic realism failed to furnish. And the idealist of modern times has done no better. He, too, recognises the sensible as the inexplicable phenomenon organised possibly into a system of knowledge by the innate forms of the cognitive faculty, but remaining still unexplained both as regards its appearance and its evidently deep and unique relation with reality. Materiality, so far as its forms are concerned, is

resolved into a projection of the forms of the cognitive instrument; so far as regards the most permanent of its sensible qualities—its hardness, solidity, resistance—these, like all the others, are recognised as, *ex hypothesi*, at the best transitory and unreal.

Indeed in its modern Kantian form, Idealism, as it is called, labours under a still more serious difficulty. It finds the origin of the *a priori* and abiding elements of experience in the constitution of the mind. It locates them in the cognitive faculty itself. But it for long failed to realise what is now, however, pretty widely appreciated, that in so doing it practically denied the possibility of *real* knowledge. If knowledge in its search for truth is perpetually limited by its own forms, its cognitions, however necessary and imperative, can have no valid and effective reference to the real world. If, for example, space is a primitive intuition, we may thus account for the self-evident truth of geometry, but we cannot account for its applicability to the external world—an external world which we can never really know if the forms of things are determined for our cognition by the structure of our own faculties. The rational explanation of experience must not require the employment of an unknown and unknowable key. In some way we must find the explanation within our experience. On the other hand, if we are to explain experience we must get beyond the cognitive faculty. Merely to set forth the implications of

our own cognition is of no avail. It leaves us with a purely subjective idealism, a theory which, as we have so often seen, is a mere denial of the undeniable convictions of our daily life.

How, otherwise, can these two requirements be satisfied and harmonised except by the postulate of power, furnished by and derived from our own activity, yet discovered in that activity as also the unifying explanation of all the diversities of the object world ?

To reach the Real we must transcend not only sensation but cognition. We must get beyond our conscious selves, yet we must *not* transcend experience. The Real, therefore, can only be found in the other — the non-cognitive — the exertional element of our Life, and that element being also that which interacts with and which participates in our environment, seems obviously *the* element from or by which we derive the knowledge of the independently real. In our exertional Activity we are linked and intermingled with the dynamic system which constitutes our environment. Community of knowledge is rendered possible by and only by this participation. When the phenomena of sense can be accounted for as transmutations of a real Energy or potency, then and only then can their appearance be explained by a theory consonant with the requirements of an intellectual Metaphysic.

XII

THE NATURE OF KNOWLEDGE

THE true theory of human cognition is to be found, therefore, in the proposition that *the idea represents action,* the sensible impression merely the obstructions which such action encounters. Our ideas are our stock of mental activities, by which we frame the fabric of Knowledge, and which are for that reason generally applicable to its interpretation, and these are not pictures of sensations but expressions of Activities. Just let any one honestly reflect on what he really means when he says, "That is an angle." Does he refer to a piece of visible colour? Does he not know that the essence, the form, the reality of the angle is not in that nor in any sensation at all; that the sensible accompaniments are mutable and indifferent; that what he really and truly means by an angle is the form of an action?

In every sensible experience there is embedded the idea, the intellective apprehension of its dynamic potency, of which the sensation is but the accompaniment and the fringe.

Leibniz truly says (*Metaph.*, transl. by G. R. Montgomery, xxvi.): "Our soul has the power of representing to itself any form or nature whenever the occasion comes for thinking about it, and I think that this activity of our soul is, so far as it expresses some nature, form, or essence, properly the idea of the thing. This is in us, and is always in us, whether we are thinking of it or no."

We habitually speak of a thing by reference to its sensible accompaniments, but we constantly distinguish them in thought. We see a line of white foam on the water. We say that is the course of the ship. But we mean really by the course of the ship a process of dynamic activity of which the track of foam is but a symbol and accompaniment. Let the reader but reflect, and he will be surprised perhaps to find that this illustration is of universal application. Every furrow in the field is, for Knowledge, the track of the plough; every line, the shape, the form, the contour of every visible thing is the expression of the potent energetic operation which has produced or is producing it—of the dynamic process which maintains it. It is true that we must ever start from a datum of observation, and with a description apparently static. Such datum is a section taken across the process of Reality. Without such data we should have no points of reference. It is by these we featurise Experience. As we shall see later on, we never give a name to an act until it has eventuated in a *fact*. That is why Matter seems so real to us.

Our visible pictures represent not action but the result or supposed result of action. No race-horse's legs ever occupied the positions in which they are visually depicted by the artist. But if we analyse such observational descriptions we find that they are built up of buried dynamics. One who did not know a plough might yet describe a furrow as a triangular cleft in the ground running in a straight line across a field. But have we not found that a triangle and a straight line are the names of acts? and is not the same true of a cleft and of a field? The mariner observes his position at noon. It is a static fact, but it is determined by dynamic changes; and is not its object to determine the course of his vessel? What is true of the visible is equally true of the tangible, of the audible, and of the whole sensible world. All tactile resistances in some way express dynamic action. Music may excite an indescribable variety of emotions in its auditors. It is only capable of becoming an object of Knowledge when its elements are apprehended in terms of the real dynamic process in which the sounds arise. When the metaphysician tells us we can know only relations, he is vaguely hinting at the truth that the cognisable Reality is a unitary energetic process of transmutation in which all sensation arises and apart from which it is meaningless. The merest child readily recognises the scantiest outline or skeleton figure as the object to which it refers, provided only it expresses truly the dynamic form, although such outline is altogether

different from the sensible appearance. How could he do so unless because he unconsciously recognised its dynamic idea as the essential constituent of the thing. Dr. Thomas Reid, in his Inquiry concerning the Human Mind, long ago proved in detail that the elements of Knowledge were not pictorial reproductions of sensations at all. Having thus removed the fallacious theory of their origin adopted by Berkeley and Hume, he accounts for them merely as the irresistible convictions of Common Sense. Had he only reached their true derivation from the facts of Activity and realised that Cognition is a mental activity which reproduces and expresses the activity of exertion, he would have gone far towards solving the first problem of Knowledge. But both he and Kant failed to locate in our Activity the true foundation of our Knowledge. And so it is that we still constantly encounter the ancient tenets of the phenomenalist and the sensationalist.

By all such it is supposed that knowledge is nothing but a collection of the impressions of sense. Even in recent times it has been affirmed that the ideas of things—even of geometrical figures—which we form in the mind are simply copies of the particular instances presented to us in Sense. Such a view, extreme and absurd as we deem it to be, seems to illustrate the impossibility of altogether getting away from the truth. For what is a copy? How is a copy made? In some way or other it is the result of an active effort.

Even were we to allow for a moment that ideas were thus derived from sense, it should be evident at least that, once formed in the mind, they are independent of the particularity of sense and applicable generally to the various instances of actual presentation. Not only so, but they are liberated from the defects of sensation. The circle which the mind thinks of is a perfect circle, and so of the angle and the line.

It may be that we cannot represent a perfect circle to sense; but that only emphasises the distinction. It may be, it *is*, equally true that we cannot frame a mental picture or image of a circle without investing it with the particularities and defects of sense. We cannot frame such a mental image of a triangle which is neither equilateral, isosceles, nor scalene. So said Bishop Berkeley with undoubted truth. But the *notion* of a triangle, as he latterly seemed to have realised and which is what Socrates meant by the idea, is as certainly general. The idea of a triangle enters into the process of discourse without any particularity, indeed apart from any definite conception of any particular species of triangle. Discourse employs and utilises what it requires. The activity of Discourse being freed from the obstructions in which sensation arises, is free also from the limitations which particularise sensible experience. That is the essential nature of the process of thought, although by thinkers like Hume and Berkeley it was ignored.

And what is true of geometrical conceptions is in this respect true also of the ideas of all other things. We do not in thinking about them frame mental images or pictures. Ideas succeed one another in the process of Discourse without any pictorial presentation. We ask any one, Is it true that ordinary discourse involves a constant pictorial panorama of the subjects discussed, many of which are altogether incapable of visual representation at all ?

The explanation, then, of this generality of our concepts or ideas is to be found in the fact that they reproduce or represent *actions*. In consequence of the periodicity of all natural processes and movements their activity is constantly repeating itself. Sensations may punctuate and individualise our Experience. The process of Thought, however, is adapted to represent action apart from the particularity of sensation ; hence the generality of conceptual Discourse.

The same considerations explain the purity or ideality of Knowledge. For if we consider the world also as an activity, we shall find the pure forms of things everywhere, not only in thought but in Nature. Discourse in its ideality is not thereby less but *more* truly representative of the dynamic process of Nature. Indeed only thus can it be representative at all. Every planet, unless in so far as it is otherwise acted upon, describes a perfect ellipse ; every bullet, unless otherwise deflected, a perfect parabola. Its flight is a perfect

compound of several pure and perfect motions. Every stone which falls to the ground expresses in its action the pure forms of the laws of gravity and frictional resistance of which its motion is compounded. All action is pure. It is with sensation that imperfection enters.

It is quite certain then that Thought, even when engaged in affirmation regarding the sensible exertional world, is an altogether different process from pictorial or phantastical reproduction of sensations. What we express in thought is the character of the thing, its form or essential nature, in short, its dynamic potency. Such form may not be always capable of complete expression as it is in the case of geometry, but that is because our apprehension or knowledge of the characters of the thing, or our power of representing them, is in such cases imperfect. These characters express the potency of the thing—that is to say, what can construct it and what it, being constructed, can do. If the construction of the thing is within my own potency, the conception of it is complete. If not, it is incomplete. It is because geometrical figures are the fundamental forms of *our own organic activity* that we can attain in their case to perfection in our ideas and reasoning. A machine is only partially within our potency, because the materials are furnished *ab extra*. Postulating perfection in these, you can conceive it as perfectly as you can a geometrical figure, the construction of which is wholly within your own power. And

although in the department of natural knowledge we may not be able from the implications of the idea to develop completely the phenomena which it manifests in actuality—as, for example, from the idea of a rose we may not be able to deduce all its properties as we can from its idea those of the triangle—that is rather due to the necessary imperfection of the induction from which we derive the idea than to any logical impossibility of such a deduction. In every case of an idea which represents our own constructions this difficulty disappears. And it is at least evident that in the case of the rose or of any other sensible object whatever, no less than in the case of a pure geometrical figure, its essential elements are noematical. Its very smell, although smell is perhaps the least intellectual and most purely sensuous of sense impressions, is simply a particular form of physical action; the expression of a particular potency in the thing, which may variously affect different subjects and which in its essence is apprehended as Idea. We cannot *know* the smell except by reference to its *action*—how it affects ourselves and others. We may feel it, but we cannot say if our feeling is the same as that of any other person. Knowledge as a common possession and the subject of Discourse must be supported entirely by a reference to the dynamic significance of the thing. The potency which our Activity discovers as the common medium of existence is the *only basis* of Knowledge. Whenever we proceed to cognise, to

think about anything, even about a sensation as subjective as smell, we are considering the action in which it consists.

We speak of rivers, mountains, men, houses, trees, in short, of all the objects of discourse, without usually framing any particular picture or any picture at all of their visual features. The blind who could never do so are as able to engage in rational discourse as the vident. Are all such unvisualised and unimaged ideas confused and meaningless? Not so. On the contrary, confusion and unintelligibility would be the first result of any attempt so to represent them. Sensation is obscure and meaningless unless and until idealised and thus rationalised. Visual sensation owes its pre-eminent value not to its "colour scheme" but to its capacity for such interpretation. Our sensations are made clear and definite when interpreted in terms of power in action. We think of the river or of the mountain as it stands related to our exertional activity, or, with a fuller and more scientific apprehension, as the expression of its own dynamic significance. Ordinary knowledge conceives of all such objects in their relation to the subject's own activity. Science proper conceives them in terms of their dynamic significance in the system of Nature. In both cases their dynamic significance constitutes their idea.

The intellectuality of those affirmations which express the sentiments of the mind is, of course, still more obvious. Take the case of abstract ideas,

such as the ideas of virtue, truth, honesty, etc. These clearly cannot have a sensible origin. Yet they form a very important element in intelligible discourse. We must find a view of rational discourse compatible with the use of such ideas as these. Indeed all abstract ideas are incapable of sensible representation, yet they form the indispensable furniture of thought. We must find some explanation of how, with such ideas as these, Discourse is possible. And the explanation is only to be found in the fact that all alike express the characters of action, and that our intellective power is adapted directly to express such characters.

The Real, then, is an active energetic kinesis. Sensibles are but the interruptions or turning-points in the constant process of experience. By these our attention is arrested. Perception is awakened by sensation. *Every* sensation arises in obstructed action. It is by and in virtue of our sensations that we identify our experiences. But it is in virtue of the potency which sustains the process and of the laws of its Activity that objects acquire their various characters and forms—characters and forms which are doubtless discovered in the sensation but which belong to the process itself, not to its interruption.

XIII

CAUSATION

It is perhaps the consciousness of the difficulties which seem to beset all theories of knowledge which has led latter-day Idealists to deny the fact of Causality altogether. For that is truly what they do when they reduce causation to a mental affirmation suggested by invariable sequence.

Here, strangely enough, they make common cause or occupy common ground with their opponents, the Phenomenalists. It was these latter who first suggested this method of disposing of the idea of causation. As Schopenhauer well points out, the question of the meaning of causation hardly arose in ancient times. It was Hume who first questioned the validity of such a postulate, and demanded its credentials. He perceived clearly enough that if the sensible presentation flowing in a constant stream over a purely passive consciousness constituted the entire groundwork of experience, there was no warrant for the postulate of cause; and he therefore found an explanation for it in his favourite appeal to custom and habit engendered by invariability of sequence.

If the verity of the postulate had been accepted without question up till Hume's time, the validity of his explanation has been accepted since with an almost equally childlike faith and confidence.

Even Kant, though he supposed that the notion of causation was imposed upon the presentation by the categories of causality and dependence, and that it thus derived its character of universality, did not attempt to dissociate, or, at least, did not succeed in dissociating, it from the idea of invariability of sequence. The same principle is sometimes expressed in the statement that causality is a nexus mentally established in virtue of repeated coexistences of similar recurrent phenomena. And since Kant's day even a thinker so orginal and unconventional as Schopenhauer has explained causation in terms which are almost repeated by the latest of the Neo-Hegelians.

And, indeed, this strange agreement between schools so diverse is not so inexplicable as it might at first appear. We have seen that the defect of realism is the impotence of ideas amidst the things of sense. It may be said that the defect of phenomenalism is the impotency of sensation amidst the things of thought—the things, that is, which thought obliges us so constantly to postulate and affirm.

But in either case it is vain for the supporters of such a doctrine to pretend that they thereby explain the mental postulate of causality. At best they explain it away. If invariability of sequence

is the true explanation of the postulate, then the affirmative judgment is constantly wrong, and the fundamental conception which lies at the root of our belief in the reality of the world around is based upon a constant error.

And the failure in both cases is traceable to the same source. Both Idealists and Sensationalists have overlooked the significance of our dynamic activity amidst the things of sense. A few very acute thinkers have from time to time pointed this out. As these men have maintained, it is in our sense of effort, in the experience of our dynamic activity, that we must find the origin of the postulate.

The explanation of causation by reference to invariable sequence is based upon an essential misconception of what causation means. In point of fact we never regard one phenomenon as a cause of another; and regularity of sequence, so far from being the true test of causation, is the very opposite. It is when the usual sequence is interrupted that we look for a cause, and when such interruption becomes periodic and regular it gradually seems to lose its causal significance. In many of the most invariable sequences, such as that of day and night, no causal nexus is ever suggested to the mind. Indeed, this example is a good instance of the truth that invariability tends to obliterate any suggestion of a causal nexus.

Causation is invariably a reference to potency. In every case in which I refer to a cause, I refer

to the potent energy in virtue whereof the transmutation in which the phenomenon consists is developed into actuality.

And this enables us at once to explain the difficulty so frequently stated and with so much satisfaction—the difficulty, namely, of eliminating the cause amidst the antecedent phenomena. "What," asks a recent writer, "is the cause of the fire burning in my fireplace? Is it the coals that were placed in the grate, the sticks and paper which were laid below, the match which lighted them, the housemaid who struck the match, the man who made the match, the miner who dug the coal, and so on in an indefinite regress?"

Now in every case and always our sensible world at any given point of time is a datum of configuration—a term which has its strict dynamical meaning. In stating any dynamical problem we must start with a postulated datum of configuration. That datum, as we know, has a given potential energy, and the cause of any change in that configuration is the energetic transmutation in which such change consists. Given as the datum of configuration the made-up fire, the sticks, the coal, and the box of matches beside it, then the housemaid's action is the energetic transmutation which is the cause of its alteration. Extend your range of cognition. Take as your datum the empty grate. The cause of the first change is the activity which introduces the coal. And so on; the causes are as numerous as the changes which they originate,

but what we mean by the cause in any particular case is always the activity which involves the change upon the datum last postulated. And if you take the universe as a whole, the totality of the energetic transmutation is the cause, and the totality of the phenomenal resultant is the effect.

It is therefore clear that it is on the analogy of my own active experience that I postulate causation. Were I a mere sensitive plate receptive of sensations, the idea of causation could never arise in my mind. There would be nothing to suggest the power which underlies the sensible. It is in terms of the powers which sustain my own activity that I conceive the dynamic system. That system is discovered in virtue of the opposition which my own power encounters. And this necessarily implies the homogeneity of the opponent. There cannot be opposition between entirely disparate agents. The mere fact that they *resist* one another implies a certain community. There have been nations which could not go to war because the force of the one consisted of an army of infantry, and that of the other of a fleet of ships. A battle implies a battlefield. Strange as it may sound, opponents cannot oppose unless they meet upon some common ground.[1] Thus it is that on the analogy of my own activity I postulate potent efficacy amidst the things of sense, and hence is derived in very truth the postulate of causation.

[1] Max Müller, *Lectures on the Science of Language*, i. 506.

XIV

REASON AND CAUSE

It is of the highest importance in the theory of knowledge to distinguish clearly between the two conceptions expressed by the terms Reason and Cause. And the distinction depends upon the true appreciation of the relations of the two activities of the organism—Thought and Exertion.

In ordinary conversation, as Whateley pointed out, we constantly confound the two ideas. We say, "The reason of an eclipse of the sun is that the moon is interposed between it and the earth." In reality that is the cause of the eclipse, and the eclipse is the reason from which we infer the operation of its cause.

Descartes and many other metaphysicians failed to make the true discrimination.

Schopenhauer has emphasised the importance of the distinction. According to him, the ancients constantly confounded the logical reason of knowledge and the transcendental law of cause and effect in Nature; a confusion probably traceable to the Platonic Doctrine of ideas with its failure

to appreciate the dynamic potency of Nature. The true distinction was most nearly reached by Aristotle, who clearly distinguished between defining a thing and proving its existence.

Spinoza habitually used Reason and Cause as interchangeable terms. The result was that he became possessed of the idea that if we can determine the qualities of an idea, and if amongst them we include existence, we have established the reality of the thing which such Idea represents.

The true distinction is at once seen when we recognise that in the inductive knowledge of Nature they stand in a constant inverse ratio to one another. Effects are the reasons from which we infer their causes. Causes are the conclusions which we deduce from their effects.

We say, "It has rained, because the ground is wet." The wetness of the ground is the sensible phenomenon, the effect, the reason, from which we infer the dynamic operation, "it was raining," as its cause. And this is the form of all inductive reasoning. "Because it is raining the ground must be wet." This is the form of deductive reasoning in which, just as from our exertional activity we deduce the properties of the lines, angles, and curves which are the results of such activity, we infer from the dynamic process, a fall of rain, the resulting wetness of the ground. But whenever we apply this process to natural phenomena we must be fortified by a previous *in*duction by which the causal nexus has been ascertained and established.

It is only when reasoning within the limits of our own potency, as in Geometry, that deduction can be directly employed.[1]

The result, the *effect*, of the dynamic operation is always the reason why we inductively infer that such operation took place. But that result is also *the cause of our belief* in such an operation. And it is this secondary view of the effect as a *cause of knowledge* that accounts for the ordinary conversational habit and obscures from us the fact that reasons in knowledge correspond to effects in Nature and conclusions in knowledge to causes in Nature.

[1] *φύσει μὲν οὖν πρότερος καὶ γνωριμώτερος ὁ διὰ τοῦ μέσου συλλογισμὸς ἡμῖν δ ἐναργέστερος ὁ διὰ τῆς ἐπαγωγῆς.*

Anal. Prior. ii. 23. Induction, the process which leads from Effect to Cause, affords to us the most palpable proof; but in Nature, *i.e.* following the process of Nature herself, the development of knowledge is by Deduction.

XV

THE TRUE ORIGIN OF THE POSTULATE

THE true origin of the postulate of the affirmative judgment should now be more evident.

All agree that reality is a mental affirmation, but it does not necessarily follow that it derives its existence from thought. The affirmative judgment of the waking consciousness involves the two terms of a proposition. What is the predicate? The true key is to be found, let us once again repeat, in the fact of my activity. My activity is twofold. I not only think, but at a much earlier stage I move. My motor energetic activity is apt to be confounded with its sensible results, but, regarded as an operation, it is the expression of a something which we call power. In calling that something *power* we are describing it by its effects. We are simply saying that action implies that which acts, and that we shall call that which acts by a name connoting capacity for action. The essence of power, then, is capacity for action.

Our activity amidst the things of sense is the activity of exertion. It implies power, it requires

power, it exhausts power, it uses up the transformability of energy. And we postulate a similar power in the opponent. The sensible world is a kinesis. The actuality of phenomena is transmutation. Transmutation takes place in the face of opposition, and we postulate power as that which can effect the changes which do occur. When I say the horse draws the cart, what I fundamentally mean by the horse is not the colours I associate with that name, but the potent agent which they represent. In like manner when I say the sun ripens the grain, or simply the sun shines, or when I describe any other physical change, I postulate as a cause the agent or unseen potent author of the transmutation. Even when I say something stands still, or merely exists, such stationary existence implies potency, a potency which sustains in their persistence the phenomenal changes whose constancy is embodied in its presentation. Solidity implies power, resistance implies power, even existence does the same. Everything which affects the senses involves the potency which enables it to do so. The permanencies of the sensible being all permanencies of change require to be sustained by power.

That the reality of the cogitant ego is an inference from its activity was the proposition with which Descartes inaugurated modern philosophy. His famous maxim implies, not as is so often said, that my thought is the cause of my existence, but rather, that from the fact of my mental activity I

infer the reality of the cogitant ego as its cause. And in like manner from the facts of my exertional activity I postulate the agency of power. I recognise myself as potent to effect changes in the sensible environment;[1] changes which, unlike the activities of thought, are effected in the face of opposition, and require power for their production; and I therefore postulate a similar and homogeneous power as the sustainer of the environing opponent.

The actual is possible as actuality in virtue of the potency in which it exists ἐν δυνάμει, and whose capacity for evolving itself into actuality made its actuality possible.

So said Aristotle, and so says the latest science. Reality, then, as the subject of discourse is an affirmation; but such affirmation is a representation of dynamic activity as the potent sustainer of the sensible world.

[1] Referring to Dr. Thomas Brown's essay on *Cause and Effect*, Sir John Herschell observed: "It is vitiated by one enormous oversight, the omission, namely, of *a distinct and immediate persona consciousness of causation* in his enumeration of that sequence of events by which the volition of the mind is made to terminate in the motion of material objects. I mean the consciousness of *effort* as a thing entirely distinct from mere *desire* or *volition* on the one hand, and from mere spasmodic contraction of the muscles on the other."

XVI

THE IDEA OF MATERIALITY

But if power is the true postulate, why has the conception of three-dimensioned materiality so long held the field? To answer this question we must understand in what materiality consists. We should note that the advances of physical science within the last three hundred years have given to the word Matter a limitation of meaning—a restriction within the confines of the imperfect concepts of atoms and molecules—which it did not suffer when employed by those of earlier times. Bacon and others, in speaking of Matter, often mean rather what we should imply by "the physical." The contraction of the idea reached a climax when Heat and Light were distinguished from the material as Imponderable forms of the physical reality. It has been gradually broadening since. It now seems probable from a mere consideration of the elementary facts of sensible perception that smell is not occasioned by the bodily dissemination of particles, but by some form of undulatory impulse. No one who reflects on the ordinary

phenomena of the radiation of heat from the soil —the ordinary changes which produce a frosty morning—can doubt that, apart altogether from the ether, the atmosphere is very inadequately described as composed of a collection of material particles.

Still the idea of solid material particles as the *basis* of all physical phenomena for long appeared inevitable and intuitive, if not necessary. Any dynamical resolution of such a concept seemed to be vitiated by the fact that it was only by means of and on the assumption of such a postulate that dynamical reasoning could proceed. In the synthetic construction of the fabric of physical knowledge we easily and naturally start from the datum of the sensible presentation, which, therefore, in all such reasoning appears as its inevitable basis, the denial of which would be simply destructive. But it is quite otherwise when we proceed analytically to investigate this basis itself. So proceeding, we find that these apparently basal concepts are, in fact, not simple but compound, that they are the product of a combination of visual and tangible impressions, with concepts representing our Activity. In the last analysis we have no right to assume the reality of material masses, however minute. Eliminating visual data which are obviously not fundamental, we find the basal features of materiality are all referable to the experiences of our Activity amidst the environing Powers of Nature.

These powers or potencies of Nature, amidst all their multifarious variety, act not sporadically but constantly, and according to law. Recognising them by their operations amidst our sensible environment, we describe them as operations of natural force. The fundamental features of materiality we ascribe to the so-called forces of cohesion and gravity. We call them fundamental, and for us they are so, for they determine the phenomenon which we call body, and that in the last analysis is a constancy of energetic action which forms the condition precedent to our motional activity, indeed to our whole organic life. The transmutations of which such forces are manifestations obey definite laws. These laws determine the fixed constancies we call bodies,—including our own. They determine the form of materiality, including its form as revealed in vision,—because the visual form directly corresponds to the dynamical form. In other words, spatial form is a discovery of our organic activity operating under the tensions of the physical system, and is the form or general law of such activity amidst such tensions.

Our activity originates within this dynamic system. The operation of this process of transmutation is *the precedent fact* which generates and establishes the system of mobile masses in which materiality consists, and in which, therefore, organisms are possible. Matter, then, is phenomenal. Its constancy is but a constancy of certain forms

of transmutation. Its elements, as Berkeley showed, are merely abstractions of sensible data. By such abstractions you cannot transcend these data themselves, but these constant processes, being the condition precedent to the existence of the organism, are for it fundamental.

The postulation of matter, therefore, is no mere arbitrary expedient, but is directly based on the conditions of physical existence. None the less is it evident that materiality is not reality. Its so-called qualities are phenomenal. But the phenomenon is a kinesis. It is, as we have seen, a transmutation. The form of materiality, therefore, however phenomenal, is an expression of the laws which determine these transmutations. It partakes of the characters and expresses the inner nature of the real. But it is not itself Reality. It is a change which Reality undergoes. The true postulate, therefore, is power, not materiality. The qualities of matter, viewed as such, are unreal, but no such objection applies to the simple postulate of power. Power is no mere hypothetical abstraction of sensible forms competing with the vortex atoms, frictionless fluids, incompressible molecules, ethereal undulations, and other hypothetical explanations of the phenomena of nature. Potency is not an abstraction of sensible data at all. It is a pure noematical concept. Nor is it a speculative hypothesis. It is that conceptual postulate which every human being necessarily frames and uses during every day and every hour of his conscious life,

because it is based on and suggested by that first of facts—his own constant activity—the very fact in virtue of which, and of which alone, we not only *act* but we *reason* and we seek to know—that very fact the recognition of which rather than any vain preference for the number one explains our constant effort to reduce the real to unity. This is the Aristotelian view of matter—a potency ever transmuting itself into actuality, and containing within itself the capacity for such transmutation,—a reality which constantly undergoes transmutations, and of which the transmutations themselves constitute the phenomena of sense.

All the fundamental qualities of matter are, therefore, discoverable in and derivable from our activity.

Take its solidity and resistance. This quality is obviously discovered in the course of our exertional activity. From the sensations which accompany our exertion and which, so to speak, define it, we infer both the fact of our own potency and of opposing power. And what are the features which we discover? They are the features of the process in which materiality consists—the process of which the sensible manifestation is what we call cohesive force. But for the necessity we are under to overcome resistance, we should never discover these qualities or learn the fact of our own and our opponent's potency. Both are discovered together. The one implies the other. Potent agency is an inference which we make from such sensible experiences

associated with our own activity. The process of sensible change is not sensation, but action. Thus our active experience is the basis of our ideas of resistance and solidity. Resistance is no doubt discovered in and by sensation. It is an idea descriptive of the fact that activity is impeded. Solidity is just another aspect of the same fact; though both terms are often employed to denote the sensible accompaniments of such obstructed action.

It is important not to confound Mass with Resistance. The latter is a stress involving *two* opposing masses. It is altogether erroneous to import into the concept of Mass any of the sensible features from which the idea of Resistance is derived. In abstracting from the data of experience the element of massive materiality, many are apt merely to remove in thought all objects which resist our activity, and to forget that such abstraction requires not only the removal of all opponent or resistant bodies but of our own organism also. Consideration should therefore make it clear that the elimination of the dynamical element of our experience carries with it mass and spatial extensity, in short, the whole basis of the Material World.

The most fundamental quality of matter, however, is probably felt to be its alleged indestructibility. Amidst all changes which it may undergo its quantity remains undiminished. This, then, is the primary and immediate test of reality. But when once we realise that materiality is in essence

a transmutation process, we readily apprehend the true significance of this proposition. It is the process which is constant; and indestructible—at least by us its creatures. Apart from the operation of cohesion, massive materiality would not enter into our phenomenal system. No doubt in ordinary language we explain cohesion as a force of attraction between particles of matter, and such an explanation seems to presuppose their reality. But such particles are merely hypothetical postulates. From the standpoint of pure dynamics a datum of configuration is the starting-point from which the reasoning proceeds; and stresses, conceived on the analogy of personal physical effort, are the stages which mark its progress. And in reasoning upon such sensible datum a force simply records the rate of transmutation, and a constant natural force the constant rate of a constant natural transmutation. The continuous and uniform operation of this transmutation process, giving rise to the phenomena of massive materiality, is the condition precedent to the actuality of those phenomenal groups which we call bodies. It is, therefore, the condition precedent to the operation of our activity, and of the opposing activities which involve us. Hence it is evident that matter must be by us indestructible—indeed, indestructible by any dynamic action *within the system thus established.*

This is what indestructibility means, and is all that it can mean. We cannot for a moment affirm that it is ultimately and absolutely impossible that

matter should be destroyed. We do not, in point of fact, know that the quantity of matter in the universe is constant. Least of all is there any evidence for the assertion so gravely made by Schopenhauer that the destruction of matter is inconceivable. On the contrary, not only is it conceivable, but the total destruction of all matter has been an article of religious belief on the part of many just as much as its creation out of nothing. It is merely destruction by our power or by the powers of Nature we know which is inconceivable. If what we mean by indestructibility of matter depends upon our taking a complete inventory of the universe, the ascertainment of the fact, if fact it be, is obviously hopeless, and the universality of the doctrine must be spurious. But if the doctrine is relative to our own potency and dependent on our knowledge of its limitations, its universality within such limits is both intelligible and ascertainable.

It is true that, in ordinary dynamical reasoning about motion of mass, matter is often postulated as well as energy or power; but that is so because the phenomena studied *are* motions of mass, that is, transmutations of energy which presuppose the transmutation in which mass consists. What is really postulated is merely a sensible datum of configuration and certain supervening activities; and all such reasoning can proceed, and does proceed, in terms of energy transmutation without involving the postulate of the *reality* of any material substratum.

From the standpoint of scientific observation, our physical organism being a mass, the transmutations of energy, in virtue of which massive phenomena occur, are the condition precedent to the study of motional change, and the assumption of these constancies as a datum marks the starting-point of the inquiry as it interests us as active agents therein. Hence the utility of the idea of materiality. Hence its inevitable constant employment. But in thus displaying its true meaning and use, we at the same time illustrate its truly relative position with reference to reality.[1]

[1] The energy of a mass in motion is usually termed *kinetic*. Our sensible experience is determined by the kinetic energies of our environment. But the energy of a mass, when that mass ceases to move, is never lost, but is transmuted into some other form. It may, for example, be transmuted into the kinetic energy of Heat. If, again, a body moving in opposition to Gravity is brought to rest, its energy becomes dormant and is denominated *potential*. The whole physical universe is in a state of tension due to the constant operation of Natural Forces, and it is in virtue of such tension that a body has potential energy. The energy which a body at rest possesses in virtue of gravity and which we call its weight, is therefore one example of potential energy; the energy of chemical separation is another instance; and the Solidity or Resistance which a body possesses in virtue of what we are pleased to call Cohesion is a third. Speaking generally, it is to our consciousness of the persistence of *potential* energy that we must trace our deep-seated conviction of the "reality of Matter." Possibly, indeed, as has been suggested, all energy may be ultimately kinetic, but for practical purposes we cannot dispense with the useful and usual distinction between its kinetic and potential forms.

XVII

EXTENSITY

What has just been said of the idea of matter is equally true of space,—a concept which is simply the complement of the concept of matter and expresses our apprehension of the possibility of free mobility—an idea complementary to that of resistance, whilst the infinity of space simply expresses the almost identical proposition that within the system of massive materiality wherever activity is not limited by opposition it is unlimited and unopposed.

None the less is it remarkable how many of those who have studied the subject have failed to appreciate how the concept of space is formed and derived from the facts of our own activity. And if the derivation of the basal conception of space from the facts of our motor activity has been overlooked, it is equally remarkable how many have failed to perceive that the conception of the world which we construct with the aid of the data of vision is similarly composed.

Apart from vision, Externality—mere otherness—

is not qualified by extensity. Our conceptions of space are quantified by a reference to time, that is, to the intensity of the sensation by which our exertions are estimated.

In vision we are presented with a multitude of sensible experiences *simultaneously*. Indeed we have a systematic simultaneous presentation of the principal features of the dynamic environment. Thus it is that visual space acquires the peculiar character which we call extensity. The effectiveness of our Activity is thus greatly augmented. But it is still of the potent dynamic world that the visual scene is the presentation and the plan. Extensity results from the application of simultaneity to activity.

This view of the relation of extensity to vision is confirmed by an examination of the *inferences* involved in the act of vision, to which our working conceptions of matter and space are very largely indebted. The importance of vision was first recognised by Aristotle, but the most illuminative study of its meaning is to be found in Berkeley's famous *Essay*.

Berkeley is generally credited with the discovery of the proposition that distance is not immediately given in vision, his reason being that the object of vision is a ray of light projected endwise on the eye. In point of fact Berkeley assumed this as self-evident, and proceeded on this assumption to develop his theory of vision.

It would almost seem as if Berkeley had not

appreciated the full significance of his postulate, for if vision is effected by a line projected endwise on the eye, it would seem as if it excluded extensity even in two dimensions or one.

And it really is true that spatial extensity in every form and degree is not an immediate datum of vision, but arises from the constant intellectual interpretation of visual data in terms of our activity.

The original datum of vision is ascertainable by finding what is actually wanting to the totally blind, and that is found to be the colour sense only. The properties of externality in the three dimensions of solid geometrical figure are cognisable by the blind and can be taught to them. It follows that these properties need not be immediate data of vision; and this implies a great deal more. It implies that there are ideas of spatial properties which are common to the blind and the vident. The knowledge of these properties is not, then, derived from the data of any of the senses, either touch, vision, or muscular sense. They are the properties, the common laws, of our exertional activity amidst our environment. To the restored blind all objects at first seem "in the eye," or, rather, not projected at all. This is a tactual localisation, or localisation by tactual reference, because although the nerves of sight are not sensitive to touch any more than those of touch are to sight, it is probably suggested by the operation of the eyelid in shutting off and revealing the visible and thus affording a tactual reference. It is by reference to our activity

that we establish a visual association with exertional data. There is no other possible means whereby we can ascertain and determine the relations in which visual sensations stand to tactual sensations. This co-ordination is accomplished by the ascertainment of the relation of visual sensations with tactual sensations not immediately felt at the moment but brought into consciousness by active exertion on our part. By reference to exertion and touch we discover the visual co-relatives of tangible resistant bodies. By similar exertions we ascertain the amount of effort which has to be made in order to pass from one such sensation to another, and hence arises the notion of distance. In exertional experience the co-relation is primarily by means of the time reference. The simultaneousness of the visual presentation converts this reference into what we call spatial extensity.

It is difficult at first to realise that extensity is not necessarily given in vision. But so it is. The notion of extensity arises because visual data are presented simultaneously, and are utilised as the unfailing symbols and guides of our activity. A multifarious combination of sounds does not similarly suggest extensity, but no doubt would do so if sounds were used as the constant guides of action. If our world, if our plans of action, were arranged by reference to the sounds emitted by environing objects, the various sounds would gradually acquire a relation of the nature of visual extensity.

In pure vision it would at first appear evident that form is immediately given. Is not the round globe of the sun or the form of this rectangular page given immediately in vision? We reply yes, but such form is not *per se* extensive any more than is the form of musical sounds.

The simultaneous presentation of a multiplicity of sensations is one condition precedent to the formation of the concept of extensity, the use of this presentation as a guide and instrument of our activity is the other. And the fact that we so use the visual picture gives it its character of extensity which to Descartes seemed even the most essential quality of Matter.

Ever since Berkeley's day considerable discussion has gone on as to how, assuming that distance is not directly given in vision, we do perceive things as outside of us, that is to say, how vision naturally and, so to speak, instinctively suggests the exertional facts of externality. The explanation is to be found in the peculiar physiological structure of the organ of vision in its relation to the nature of radiant energy. Essentially the eye is a convex lense, and is consequently incapable of clear vision of objects within the focal distance of say ten inches from itself. Thus naturally and from the first we learn that a certain amount of exertion is usually required to pass from a contact with the eye to a contact with the resistant object. This originates the idea of distance, and the farther distantial relations of all visible objects with our exertional

activity are the constant discovery of our earliest consciousness. The perception of the variations of distance, involved in what is called the perception of solid form by which we distinguish between a flat surface, such as a picture of a solid object or a multitude of solid objects, and these objects themselves as discovered to our activity, is now known to be due to the dissimilar perspectives which result from binocular vision. This was admirably proved by Sir Charles Wheatstone by the construction of the once popular stereoscope, in which, by artificially producing in the case of a flat pictorial surface the same perspective effect which binocular vision usually affords, he at once succeeded in establishing the suggestion of solid form even in the case of absolutely flat surfaces.

Sometimes the impression of relief or projection is produced by simply limiting the field of vision, as in looking at a picture through a tube. In such a case the explanation is as follows. Ordinarily the flatness of the picture as contrasted with the projection of other surrounding objects is made evident by the very fact that it is placed in contrast with them. When, however, the contrast is excluded and the picture looked at alone, the mental conviction reasserts itself, and we think of the object shown in the picture as really projected. The contrast with the dissimilar perspectives of surrounding objects being withdrawn, the mind is free to interpret the picture in accordance with its own past experience and belief. In such a case the sensation

is exactly the same, whether the picture is seen through the tube or openly and without limitation of the field. The projective suggestion cannot, therefore, be contained in the sensation. Its undoubted source is the mental interpretation of the sensation by reference to the experiences of my activity.

Frequent experiments have proved that the interpretation of sensations in reference to externality is in main the result of experience. Now, of what experience can it be the result? Only of our activity. It cannot be an interpretation of the sensations by any other sensation which, being equally subjective, could never originate the idea of externality.

Such perception of relief in some of the lower animals seems to be practically immediate from the moment of birth, for the newly-hatched chicken appears to possess it in perfection. This might seem a difficulty in the way of the suggestion that it is an interpretation by reference to activity, but in such cases the immediacy is the result of the accumulated experience of generations and is instinctive or organic from the first—an inherent capacity built up in the organism, but originally derived in the same way from exertional activity.

The two paradoxes of vision, so called, are explained in the same way. Both are accounted for by the interpretation of our visual sensations with reference to our activity.

XVIII

THE TWO ACTIVITIES OF THE ORGANISM

THE dynamic process of Nature is discovered to us originally by its results or, more correctly, its accompaniments. These are the sensible phenomena which constitute so engrossing an element in our experience. Yet we have seen reason to believe that this process in itself is very different from sensation, that sensation only arises when it is in some way obstructed, and that whilst the laws of the process may be expressed in the forms of the sensible presentation or may be correspondent thereto, it is a fatal error to identify two things so entirely disparate albeit so closely connected together.

Now, if these statements are true of nature as a whole, they are equally true of that portion of it which I call my organism.

My body or organism is presented to consciousness *ab extra* in the same way as any other natural agent — through the sensations which arise in consequence of its activity. Yet these sensations but record the friction by which that activity is

attended. They are like the sparks which fly from the engine wheel, or the foam which marks the line where the waves break upon the shore. We must not mistake the sparks for the engine nor the foam for the ocean.

But my organism is also cognisable in another very different and more immediate way, namely, as the sentient and potent subject of experience. Indeed, if we banish from our Mind the visual appearances of our Body, we are left with nothing but a feeling, breathing, moving, thinking organism—a united company of invisible Activities and Resistances.

Regarding it, therefore, not as a system of sensible presentations, under which form it enters as phenomenon into consciousness, but, as it is in itself, a potent agent, we find that it includes several distinct activities.

First, we have the process of transmutation in which materiality, in which the body itself, consists; but this we may put aside from our consideration, because its function is to sustain the system of masses or bodies which constitutes the *condition precedent* to organic existence. *Our* voluntary activity in no way controls or influences this system, but is superinduced upon it. This process, therefore, cannot contribute any materials to the affirmative judgment.

In the next place, then, we have that constant activity in virtue of which the processes of growth and nourishment are sustained.

In this case also our originative activity takes

almost no part in the operation. It therefore does not directly contribute to the construction of the fabric of what we call knowledge.

We have left, then, two principal forms of activity—

1. Musculo-Motor Activity—the activity of effort.
2. Noematical Activity—the activity of thought.

The former of these is at least distinguished from the latter by two marked features, namely: (1) that it is constantly resisted by an opponent, that it is involved in an environment, and that the consequent obstructions to its operation give rise to sensation; (2) it is characterised by that peculiar feature which we call Direction. It is vectorial.

On the other hand, Noematical activity is unobstructed and unlimited by any opponent, although when the process is arrested it becomes phantastical; a result curiously analogous to that which in motor activity gives rise to sensation. It is, moreover, without Direction.

The fundamental error of Berkeley, Hume, and the school which has followed them has consisted in the extraordinary idea that noematical activity is essentially phantastical, that ideas are faint sensations, and that thought is therefore limited by the conditions of sense. On the contrary, the truth is that thought—noematical activity—unless when arrested, is adapted to represent not sensation, but motor activity. Such motor activity, having been distinguished as we have seen from sensation, is found, on the other hand, capable of representa-

tion by the activity of thought. Notwithstanding the marked difference which we have already noted between them, the fact remains that they are both activities. To that extent, therefore, they are homogeneous, and thus it is that motor activity is capable of representation in thought. And it is in such process of representation that our noematical activity primarily consists. Ideas are not pictures of sensations, but expressions or representations of our dynamic activity.

The process of thought reproduces and represents the dynamical process sustained by the activity of living organisms and the constant activities of nature which constitute our environment. It is the energetic transmutation itself which is represented by thought, and in the representation of which knowledge and science consists.

Herein lies the germ of truth to be found in the Platonic doctrine of ideas. All science, as Socrates pointed out, is constituted by ideas, that is by noematical activity. Things are the objective co-relatives of thoughts, and thoughts, on the other hand, are the mental representations of things. But both are activities.

Our motor activity, or exertion, as we call it, from the fact of its constant limitation by opponent power, discovers two main divisions or degrees—

1. The exertion required to overcome inertia.

2. The exertion required to overcome the resistance of external force.

The former of these two more nearly resembles

the activity of thought. Its exercise and conditions are entirely self-contained within the organism, and thus can be perfectly represented in thought with a certitude and completeness altogether distinct from the most minute accuracy possible in the estimation of the forces of nature. When so represented, they constitute the laws or properties of spatial form. These we can conceive and represent in Thought, though, of course, without sensible signs expressive of motor activity itself, we cannot reproduce graphically their vector character. The study of the expression of mental noematical activity has hitherto been the work of logic, but the advance of meta-geometry has suggested its study from the mathematical standpoint, as being a form of activity wider and less limited but otherwise similar to the organic motor activity of which geometry is the proper science.

It is in the second division of motional activity that sensation arises and that the resistances scientifically termed "dynamic stresses" occur. The forms of these being dependent not entirely on the organism, but partly also on the transmutations occurring in the environment, can only be learned imperfectly—by observation and experiment.

It is in these two exertional activities with their accompanying sensations that experience consists.

But however obvious it may be from a candid examination that these are the constituents of our experience, the acceptance of the truth has for ages laboured under a fundamental difficulty which has

greatly favoured the imperfect truth of the Platonic realism, not to mention the contradictory doctrines of Materialism.

If it were difficult to establish any causal nexus between the ideal and the sensible, if it were hard to see how the idea could participate or be effective in the world of sense, it has been equally hard to isolate in thought the dynamic potency of which the sensible world is the expression, and in terms of which we may explain its multifarious transmutations. Man could indeed always frame the idea of power, and could conceive of power as effective of changes amidst sensible things. As knowledge progressed, he realised the operation of the permanent forces of nature causative or productive of the various regular and periodic movements of the sensible world. But the constancies and permanencies of the sensible datum—the so-called material world of our environment—in their very permanence seemed to suggest passivity, not action, and thus to be contrasted with and distinguished from the actively potent. The permanent element in the phenomenal system seemed by its very fixity to imply the reality of that system. The spatial features of the object world seemed, therefore, to have their foundation in the sensible itself, and thus to involve us ever and anon in the contradictory effort to find reality amidst what, notwithstanding its passivity and permanence, is nothing more than transmutation. The view that power is the real thing which underlies the phenomenon is,

therefore, difficult to maintain until we are in a position, first, to isolate the concept of power, and then to relate or co-relate with it the sensible presentation.

Another reason for the persistence with which the self-contradictory doctrine of material reality has prevailed is to be found in the fact that by its instrumentality we can co-relate organism and environment. Both can be conceived as bodies, and the utility of such a common concept is in practice so great that it for long defied all the destructive criticism of the reflective. No doubt Aristotle recognised that nature was in essence a ceaseless energy constantly kinetic, but, even if he understood, he does not seem to have attempted to explain how the permanence of material solidity could be harmonised with such a view, under which we are obliged to regard it as simply the permanence of a process. At any rate he was unable to equate power and sensible phenomenon, and thus satisfactorily to establish their causal nexus.

An explanation of the strength of the concept of materiality is to be found, therefore, in its mediating efficacy. Whatever differences may otherwise separate the various elements of the sensible world, however much the organism may in chemical, physiological, or any other respects differ from the inorganic environment, materiality is that one feature of which they both partake in common.[1]

[1] When I say, "I move something," "I do something," we must remember that the ego referred to is not the Mind, the Thinker

Hence the great convenience of interpreting the sensible world in terms of matter and motion; hence the persistence with which men have clung to the belief in the reality of matter; hence, also, the reason why science, with this assumption as its main postulate, has progressed so far.

But notwithstanding the convenience and utility of the idea of matter, the fact remains that potency is the only *real* postulate necessary to explain and unify experience. Kinesis or constant transmutation of that power and certain fixities and constancies of change are necessary developments of the conception, but potency itself is the only real postulate.

Viewed from within, the organism is a system of powers in action—activities, of which the two which are significant for knowledge are the two which in this chapter we have attempted to describe.

The possession of power is not *necessarily* accompanied by sensation; the fact of being embodied occasions no sensation; indeed, the constant normal free transmutations in which the vital process consists occasion no sensation. Sensation, as we have seen, only arises when some obstruction or conflict, some opposition or interference with natural operations, is encountered. Examples of

it is the energetic organism which is really meant, and that organism is a unitary system of powers homogeneous with the Powers amidst or against which its Activity operates. The concept of Matter expresses this homogeneity. Sensation does not arise in virtue of some supposed perplexing interaction between Mind and Body, but in virtue of interaction between Bodies.

this are to be found in all those interferences with the normal operation of the bodily functions which give rise to what we call pain. The external tactual sensations arise in obstructions of the motor activity of the organism. The special senses are also stimulated by interferences with the process of energetic transmutation.

It is in these obstructions and by inferences from them that we discover the opponent. That opponent is the postulate which, on the analogy of our own activity, we are obliged to assume in order to explain experience.

And we can thus explain it.

The ineradicable defects of Platonic realism as well as of modern idealism are that whilst they offer an explanation of the formal, necessary, and, if you will, the regulative elements in our sensible experience, they fail to account for the objectivity of these, and they further fail to account for the actuality of sense itself. The disciples of Idealism admit that an irresolvable residuum is unaccounted for. But what is this irresolvable residuum? It is nothing less than the entire system of Nature in which our life is involved and by which our experience is replenished. But is this satisfactory? Is it tolerable that metaphysics should claim the right with a waive of its hand to dismiss Nature as a negligible quantity, an unresolvable residuum of experience?

It seems altogether intolerable, but it is equally unnecessary. By the establishment of the theory

of Nature which regards sensible phenomena as transmutations in an ever kinetic energy, we are now at length in a position to explain and account not only for the objectivity of the formal and necessary elements in experience, but for its sensible particulars also. There is not now, in point of fact, a single sensible impression, however trivial or disparate, which cannot be accounted for and to which we cannot assign its appointed place in the system of Nature thus interpreted and realised. The cardinal defect of the Platonic realism is thus for ever amended. The pure datum of sense, the residual product of metaphysics, which no previous postulate has ever enabled us to locate, is now completely related and developed as part of a unitary system.

However much the sensible is in effect interpenetrated by the rational, however confused and meaningless it in itself may be, it was surely a very serious residuum to be left with, and that particularly so because one could not but feel that by its mysterious relation with reality it afforded the only sure clue to the distinction between the Real and the Ideal. This relationship, however, is now no longer mysterious; and not only is it not mysterious, it has become luminous. On the theory of energy we understand at once not only how the sensible is merely transitory, but how it nevertheless stands permanently related to the real. The nexus which unites actuality and potency is laid bare to view.

People have puzzled much over the difficulty of

conceiving how one thing can act on another; how motion is possible in the static system of materiality; how Mind and Matter interact, and so forth. These difficulties arise entirely as the result of vicious theory, and altogether pass away when we realise that Nature is a vast, ever-transmuting Energy. Things enter knowledge in virtue of the mental act of affirmation or representation. They are the affirmations by which we express the Activity of the Nature process. We accentuate and featurise that process by denotation of the breaks, interruptions, turnings in what is, nevertheless, a constant, continuous flow. To these our attention is called by the sensations which accompany such breaks, and which thus become to our Minds the qualities of the things or objects into which we hypostatise these punctuating facts. Take a walk. Think what that process of activity is. Surely altogether other than sensation; yet, apart from its accompanying sensations, incognisable in virtue of its very purity. So it is with all action. It is a perpetual kinesis, ever evolving in the stress of transmutation the varied phenomena of sense. The Activity of Thought and Discourse represents and reproduces this exertional activity of the organism. The punctuating sensations are represented demonstratively, but the main current of discursive Thought is either self-expressive or representative of the concurrent activity of exertion; and in such representation knowledge and science consists.

Massive materiality arises in consequence of a constant process of transmutation of Energy. Amidst this process, therefore, we come into being. The activities which constitute our personality are superinduced or superposed upon and presuppose this original process. These superposed and intermingled activities constitute our life of Exertion and of Thought. These consist principally in motions of mass. Their obstruction gives rise to sensation. Their inner nature consists in energetic transmutation.

XIX

THE LAWS OF DYNAMICS

WHEN science physical started on its career of progress there was at first no causal nexus discoverable between potent activity and sensible phenomena. Men seemed apt to suppose that inductive science was mere observation of phenomena and their qualities, and there was a danger that physical science at its start should have devoted itself to a mere discussion of the qualities or properties of matter, to a mere study of the hardness, softness, viscosity, compressibility, or other the like so-called qualities of body.

Under the guidance of Newton and his compeers a surer course was followed. Physics was developed as a study of force, of the operations of the dynamic process in which sensible movement consists, of the laws of natural action, and the relations of sensible body to potency. The great natural forces of cohesion and gravity were distinguished, and in the laws of motion the principles were affirmed, not of a mere local transference of bodies or of the appearances which they seemed to present to sense, but of transference effected by

power against force, and of configuration as a visible expression of potential energies. Thus sensible movement was from the first related with the subjective datum of power.

The laws of motion as enunciated by Newton are the fundamental principles of dynamical science.

Now these laws are not mere statements of configuration ratios. They are statements of the relations between configuration changes and physical force. It has, indeed, been suggested that they provide their own definition of force, and that therefore they are, after all, merely to be regarded as laws of motional change. But a consideration of their terms shows the error of such a view.

The first law tells us that every body continues in its state of rest or uniform motion in a straight line, except so far as it may be compelled by external or impressed force to change that state. Here it may be said the words, *nisi quatenus*, etc., imply that force is that which does alter the state of motion or rest of a body, that this is its definition, and that therefore force means nothing more than that which produces such visible result. Its quantity, therefore, must *ex hypothesi* be strictly proportional to the amount of such change.

Again, the second law tells us that change of motion is proportional to the impressed force, and takes place in the direction in which the force is impressed. Here, again, it has been suggested that the law merely provides us with a definition of force.

If this were the true meaning of the laws of motion,

they sin against the logical canon which prescribes that a definition should not contain the name of the thing defined. Perhaps, however, that would not weigh greatly with some. But then, further, if this be the correct view of their meaning, it follows that they are, after all, simply identical propositions. What would be the use of telling us that change of motion was proportional to impressed force, if by impressed force be meant only that thing which is proportional, or which we for convenience think of as proportional to change of motion? If impressed force is that which is proportional to change of motion, then, of course, it follows that change of motion is proportional to impressed force. But if that was all that Newton meant to tell us, he surely took a great deal of trouble for a very poor end. And if that were his meaning, it seems altogether impossible to regard his laws of motion as informative propositions, or to understand in any way how they could possibly have laid the foundation for the greatest development of inductive science and the greatest practical extension of human knowledge which the world has ever seen.

Indeed, if in our minds the idea described by the word "force" were in very truth nothing but that which is proportional to change of motion, it is impossible to understand how as a separate idea it could ever have occurred to the mind. If we confine ourselves to the pure visual phenomena of change of motion, and have nothing else to think of, why should we ever suppose that anything

—either force or anything else—should be required to cause such change? Unless the idea of force had been otherwise supplied to us we should never have sought for any such explanation of motional change. As Dr. Whewell showed, every science requires as its basis a distinct idea, and the distinctive existence of dynamics is due to its development of the idea of Force.

Indeed, unless we recognise the idea of Force to be distinct and definitely separated from the mere visible phenomena of motional change, dynamics become indistinguishable from kinematics. In point of fact, Force is immediately known to us by and as Resistance, just as Body is; and the estimation of Resistance is one of the primary acts of natural knowledge. Physical science is fundamentally a statement of the relations between Forces and Resistances transferred to and estimated in terms of the visible data of Configuration and Motion.

But above all, as we shall presently explain, the proportional relation which subsists between sensible change and what we call force does not apply also to the efficient power which is the postulate of practical dynamics. On such a view of dynamics, therefore, the science would have been worthless and meaningless as an instrument for the practical application of knowledge in the employment of prime motors or other sources of power, in short, in the theory of work.

But if Newton did not intend a result so futile, then it is clear that in relating change of motion to

force he referred in the word force to something quite other and different from change of motion, whose fixed relation to such motional change he desired to establish and describe.

What, then, was that other term of the proposition?

Our original conception of force is undoubtedly derived from and furnished to us by our own activity,[1] and it is the relation between that activity and motional change visibly represented with which the laws of motion deal. To refer the data of our dynamic activity to the data of the visual presentation is the first duty and the condition precedent of all science; and that is so, because apart from the simultaneity and exact quantification possible in vision, science and definite knowledge would ever have remained unattainable to man.

Now the force with which we are immediately acquainted is the force discovered in the exercise of our own organic activity. This kind of force involves material contact, and is usually described as impactive force. We soon find that another kind of force is operative throughout Nature—what we call attractive force, *actio in distans*. But experience quickly discovers that these are homogeneous and comparable with each other. And although it is sometimes applied specially to the

[1] "The notion of force is suggested to us by the so-called muscular sense" (P. G. Tait, Lecture on *Force—Recent Advances*, 2nd ed. p. 354).

former, the term impressed force in the terminology of Newton applies equally to both; and from the fact of their constancy in operation it is in the action of natural forces that the laws of motion are principally studied by him. None the less is it true that the immediate conception of force is derived from and supplied to us by our own active exertion amidst our dynamic environment.

It is in our own motor activity, in walking, and in moving objects that we discover at once the opponent and the potent. Without such activity, Force and Resistance would be unknown.

The first law, then, thus understood, affirms a constant and necessary relation between activity and motional change.

The second law quantifies this relation.

It tells us that a change of motion is proportional to the impressed force, and it further affirms that force is qualified by the property of having definite direction. A force is a directed magnitude. The vector quality implied in this expression is the most notable characteristic of the activities of exertion, and seems obviously related to the fact that exertional organic activity and all correspondent dynamic action is a process of energetic transmutation which is superinduced upon another, namely, that in which massive materiality consists. But whatever, in terms of Reality, Direction may mean, it undoubtedly is in essence a quality or feature of the energetic transmutations which involve the relations of mobile masses.

These two laws, though most clearly enunciated by Newton, were also known to Galileo.

The third law makes a further extension of our fundamental notions, and really carries us a long step onwards, for it affirms the truth that the changes which accompany the exertion of force are not merely proportional to the force exerted, but that they are, if we may so say, balanced operations.

They do not operate to create or to destroy.

They merely register transmutation in a constant potency, of which the form but not the quantity is alone affected by their operations.

This immensely important conclusion is more fully borne out by the rider to or second statement of this law which Newton stated as a corollary in the following terms: "If the action of an agent be measured by the product of its force into its velocity, and if similarly the reaction of the resistance be measured by the velocities of its several parts into their several forces, whether these arise from friction, cohesion, weight, or acceleration, action and reaction in all combinations of machines will be equal and opposite."

Though stated by Newton as a corollary to his Third Law, this proposition, as has been often remarked, might well have been dignified with the title of a Fourth Law. It extends the conception of the equivalence of dynamic operations from the simple motion of masses to all classes of the phenomena of physical change. It suggests the persistence of some indestructible Potency by which

such changes are maintained, and which amidst all such changes remains undiminished in effective quantity. Nay, more, it points us to the true test of Reality, namely, an equivalence not between oppositely directed momenta, but between the Energy referable to a given momentum and its effective resultant when transmuted into some other form. When this test is applied, it is seen that Reality is measured, and is represented by, and is proportional *not* to the Velocity but to the work done in accelerating or changing the Velocity of a mass against its own Inertia, and the equivalent work which the (positively) accelerated mass in virtue of its momentum can perform. For the Conservation of the Kinetic Energy of a moving body is proved by the fact that it forms the true measure not only of the work done upon the body in imparting to it the given momentum, but of the work which in virtue of that momentum it is able to effect. In the case of freely moving bodies the spaces covered are the true test of their potency, and these are equivalent to the squares of the time when the Force and Mass are given. The same test applies when Resistance is overcome. The penetrative power of a bullet is proportional to half the square of its velocity.

We are dealing here at length with Power—real and indestructible. Here, and not in Hardness, Toughness, Solidity, or any other sensible quality, we find the Real Thing which is in Nature.

XX

THE IDEA OF ENERGY

METAPHYSICS may have overlooked the fact, but fact it is that these laws of motion express with extraordinary completeness and simplicity the fundamental principles of the entire relation of the sensible to the exertional world.

Force, no doubt, is a mere rate, and a rate which finds its equivalent in motional change, but it is a rate of energy transmutation, a rate of change in something altogether different from the presentation of vision.

Force itself is only a sensible phenomenon, but, involving as it does the time element, it supplies a measure of the transmutations which reality undergoes.[1] And however long it may have taken men to arrive at the real meaning of the great truth involved in Newton's words, they were bound sooner or later, if the mental energy of the race continued unabated, to discover the unifying

[1] It is surely striking and important to note that Solidity, which seems to be the most real and permanent element in Experience, is, after all, a *rate of change.*

principle which underlies them. Indeed the inquiry was early inaugurated. Descartes and Leibniz, both mathematicians of original power, engaged in a memorable controversy on the subject. The problem under discussion was the ascertainment of the true value of the power possessed by a moving body; of that energy which the exertion of a given force might impart to it, and which, having thus acquired it, could in its turn impart to another. For obviously, while the force applied merely measured the rate at which power was communicated to the body affected, if we could ascertain the true value of the energy which, as a result, it thereafter possessed, we were dealing no longer with a transmutation but with a veritable real thing.

It was therefore a memorable hour when Leibniz, unanswerably refuting Descartes, established his famous formula MV^2 as the measure of the potency of a moving body; or, as bodies moving under the influence of a constant force sustain a constant acceleration, we take $\frac{1}{2} MV^2$ as the kinetic energy of such a moving mass. By this formula he once and for ever established a definite ratio for the measurement—*not* of any sensible phenomenon, *but* of real energy or potency in terms of the sensible phenomena which are the resultant and the expression of its mutations. He enabled us to *measure reality*, or at least to measure its potency in our experience.

Leibniz, in his *Discourse on Metaphysics*, gives a very simple demonstration of the truth of the

proposition for which he contended against the Cartesians. He also explains it in a very interesting way in his paper *On the Reform of Metaphysics and of the Notion of Substance*, published in 1694; and in his paper *On Nature in itself or of the Energy residing in Created Things and their Actions*, published in 1698; and in a letter to Queen Elizabeth of Prussia *On the Supersensible Element in Knowledge and on the Immaterial in Nature*, published in 1702.[1] We quote from the *Discourse*:—

"XVII. An example of a subordinate regulation in the law of Nature which demonstrates that God always preserves the same amount of force[2] but not the same quantity of motion; against the Cartesians and many others.

"I have frequently spoken of subordinate regulations, or of the laws of nature, and it seems that it will be well to give an example. Our new philosophers are unanimous in employing that famous law that God always preserves the same amount of motion in the universe. In fact it is a very plausible law, and in times past I held it for indubitable. But since then I have learned in what its fault consists. Monsieur Descartes and many other clever mathematicians have thought that the quantity of motion, that is to say, the velocity multiplied by the mass of the moving body, is exactly equivalent to the moving force, or, to speak in mathematical terms, that the force varies as the velocity multiplied by the mass. Now it is reasonable that the same force is always preserved in the universe. So also, looking to phenomena, it will be readily seen that a mechanical perpetual motion is impossible, because the force in such a machine, being always diminished

[1] See for these essays *The Philosophical Works of Leibniz*, translated by G. M. Duncan of Yale University.

[2] In this passage "force" means "energy."

a little by friction and so ultimately destined to be entirely spent, would necessarily have to recoup its losses, and consequently would keep on increasing of itself without any new impulsion from without: and we see furthermore that the force of a body is diminished only in proportion as it gives up force, either to a contiguous body or to its own parts, in so far as they have a separate movement. The mathematicians to whom I have referred think that what can be said of force can be said of the quantity of motion. In order, however, to show the difference I make two suppositions: in the first place, that a body falling from a certain height acquires a force enabling it to remount to the same height, provided that its direction is turned that way, or provided that there are no hindrances. For instance, a pendulum will rise exactly to the height from which it has fallen provided the resistance of the air and of certain other small particles do not diminish a little its acquired force.

"I suppose in the second place that it will take as much force to lift a body A weighing one pound to the height CD, four feet, as to raise a body B weighing four pounds to the height EF, one foot. These two suppositions are granted by our new philosophers. It is therefore manifest that the body A falling from the height CD acquires exactly as much force as the body B falling from the height EF, for the body B at F, having by the first supposition sufficient force to return to E, has therefore the force to carry a body of four pounds to the distance of one foot, EF. And likewise the body A at D, having the force to return to C, has also the force required to carry a body weighing one pound—its own weight—back to C, a distance of four feet. Now by the second supposition the force of these two bodies is equal. Let us now see if the

quantity of motion is the same in each case. It is here that we will be surprised to find a very great difference, for it has been proven by Galileo that the velocity acquired by the fall CD is double the velocity acquired by the fall EF, although the height is four times as great.[1] Multiplying, therefore, the body A, whose mass is 1, by its velocity, which is 2, the product or the quantity of movement will be 2, and, on the other hand, if we multiply the body B, whose mass is 4, by its velocity, which is 1, the product or quantity of motion will be 4. Hence the quantity of the motion of the body A at the point D is half the quantity of motion of the body B at the point F, yet their forces are equal, and there is therefore a great difference between the quantity of motion and the force. This is what we set out to show. We can see, therefore, how *the force ought to be estimated by the quantity of the effect which it is able to produce*—for example, by the height to which a body of certain weight can be raised. This is a very different thing from the velocity which can be imparted to it, and in order to impart to it double the velocity we must have double the force. Nothing is simpler than this proof, and Monsieur Descartes has fallen into error here, only because he trusted too much to his

[1] [A body falling from rest falls 16 feet in the first second (we use approximate figures). The velocity is constantly accelerated. Its *average* velocity during that second is 16 feet per second; its initial velocity, nil; its final velocity, 32 feet per second. In the next second its initial velocity is 32 feet per second; its final velocity 64 feet per second; its average velocity 48 feet per second; and the space covered also 48 feet. In the first second it falls 16 feet; in the first and second seconds 64 feet. A body which has fallen 16 feet has, then, a velocity of 32 feet per second; one which has fallen 64 feet or *four times* the distance has, then, acquired a velocity of 64 feet per second, or only *double* that of the former body.]

thoughts even when they had not been ripened by reflection. But it astonishes me that his disciples have not noticed this error, and I am afraid they are beginning to imitate little by little certain Peripatetics whom they ridicule, and that they are accustoming themselves to consult rather the books of their master than reason or nature.

"XVIII. The distinction between force [energy] and the quantity of motion is, among other reasons, important as showing that we must have recourse to metaphysical considerations in addition to discussions of extension if we wish to explain the phenomena of matter.

"This consideration of the force [energy], distinguished from the quantity of motion, is of importance, not only in physics and mechanics for finding the real laws of nature and the principles of motion, and even for correcting many practical errors which have crept into the writings of certain able mathematicians, but also in metaphysics it is of importance for the better understanding of principles. Because motion, if we regard only its exact and formal meaning, that is, change of place, is not something entirely real, and when several bodies change their places reciprocally, it is not possible to determine, by considering the bodies alone, to which among them movement or repose is to be attributed, as I could demonstrate geometrically, if I wished to stop for it now. *But the force [energy] or the proximate cause of these changes is something more real,* and there are sufficient grounds for attributing it to one body rather than to another, and it is only through this latter investigation that we can determine to which one the movement must appertain. Now this force [energy] is something different from size, from form, or from motion, and it can be seen from this consideration that the whole meaning of a body is not exhausted in its extension

together with its modifications as our moderns persuade themselves. We are therefore obliged to restore certain beings or forms which they have banished. It appears more and more clear that although all the particular phenomena of Nature can be explained, mathematically or mechanically, by those who understand them, *yet nevertheless the general principles of corporeal nature and even of mechanics are metaphysical rather than geometric*, and belong rather to certain indivisible forms or natures as the causes of the appearances than to the corporeal mass or to extension."

We quote also from the Essay *On the Reform of Metaphysics* as follows :—

"How important these things are is apparent, especially from the notion of substance which I give, because it is so fruitful that from it first truths, even those which concern God and souls and the nature of bodies, follow ; truths in part known but not sufficiently proved ; in part unknown up to this time but which would be of the greatest usefulness in the other sciences. To give a foretaste of them it is sufficient for me to say that the idea of *energy* or virtue, called by the Germans *kraft* and by the French *la force*, and for the explanation of which I have designed a special science of *dynamics*, adds much to the understanding of the *notion of substance*. For active force differs from the bare power familiar to the schools, in that the active power or faculty of the scholastics is nothing else than the possibility ready to act, which has nevertheless need, in order to pass into action, of an external excitation and, as it were, of a stimulus. But active force includes a sort of act or ἐντελέχειαν, which is midway between the faculty of acting and

the action itself, and involves an effort, and thus of itself passes into operation; nor does it need aid other than the removal of impediments."

The enormous significance of Leibniz's formula was not at once, indeed is not yet, appreciated. It once and for ever enabled men, who had always affirmed reality, to measure and state its quantity in terms of the sensible data of motional change.

On the very hour when that formula was written down, phenomenalism, sensationalism, idealism, agnosticism, and all the multifarious isms which have invited mankind, in defiance of the instant conviction which underlies their every word and thought, to believe that all they can know is the transitory, the sensible, and the unreal, had no longer any right or title to live. From that hour upon each of them, possibly before their birth, there was pronounced a sentence of death.

The theory was not at once complete.

The establishment of this formula left unascertained the ratios in which the various forms of sensible phenomena other than motional changes of mass stood to the potent energy of which they were but the transmutations. But the possibility of such a complete statement was evidently foreseen and foreshadowed both by Newton and by Leibniz: by Newton in his corollary or scholium to the third law of motion, already quoted (Kelvin and Tait, *Elements of Natural Philosophy*, p. 74); by Leibniz in his often-quoted fifth letter to Clark (J. B. Stallo, *Concepts of Physics*, p. 81).

The next step was taken in the study of the problem of the Imponderables—light, heat, electricity, etc.—forms of energy evidently also sustaining a causal nexus with potent reality, yet incapable of explanation by reference to the constancy of the so-called forces of cohesion and gravitation.

The exertion of power or energy involved in overcoming the inertia of mass or the resistance of opposing force is what we call *work*. The determination of the relation of work to heat, and the establishment of the definite ratio between these, which laid the foundation of the science of thermodynamics, advanced the complete doctrine of energy by another most important stage.

And now it may at length be claimed that the theory is complete—that there is not, in point of fact, one single phenomenon, one solitary instance of sensible change, which cannot be definitely and *quantifiably* stated in terms of energy transmutation.

By the establishment of the doctrine of energy, therefore, we are at length entitled to say that we can postulate *one real thing* in terms of which we can explain and account for every item in the phenomenal world. Not only so, but the account is quantitative; the explanation given is in accordance with laws which determine the whole operations of nature, not excluding the most erratic and insignificant of the things of sense.

Nature in its entirety is, after all, found to be *not* a conceptual or noematical process, *not* a system

of ideas, *but* a kinetic dynamic process. But, on the other hand, being in essence a process, it is capable of noematical representation in the process of thought.

Until recently one possible step remained to be taken.

Although the material atom and molecule are merely conceptual postulates assumed as a basis of dynamical and chemical reasoning, still as long as the use of any such postulates continued unexplained it might perhaps be felt that material atoms constituted an unsolved and insoluble residuum. But even such last remnant of the material is now no longer necessary or tenable. It has disappeared under the criticism involved in the most recent advances in Physics, under which the atomistic theory of the constitution of matter appears to have been overthrown, or rather resolved, by a theory based upon the phenomena of electrical energy and radio-activity.

Scientifically, matter can no longer be satisfactorily described as a congeries of coherent particles. Such an explanation never was really sufficient. The main result of recent advances is to present matter as the manifestation of an energetic process. The insoluble material atom is eliminated, and the theory of Nature, which regards it as in all its forms explicable as a process of energetic transmutation, is more firmly established than ever before.

An immense amount of scientific speculation has

exerted itself in recent years with the view of reaching backwards to some such ultimate explanation of the phenomena popularly explained by the concepts of Matter and Motion. So far as these speculations formulate explanatory concepts abstracted from sensible data, they are all, however useful, however ingenious, however refined, liable, when propounded as metaphysical solvents, to the very same criticism by which Berkeley demolished the reality of material substance.

For we must never forget that metaphysics as such has nothing whatever to do with the various instrumentary hypotheses by which the physician seeks to advance his conception of Nature. But we must also remember that our Activity suggests to us, and inevitably obliges us to postulate, a *meta*-phenomenal reality by which the sensible is determined, and the ontological counterpart of this psychological postulate is the concept of Energy or Potency in terms of which science can now unify and co-relate the whole phenomena of the sensible world.

The physician's datum consists in the phenomena presented to observation, and these must be carefully distinguished from the hypotheses by which he seeks to co-relate them with the general principle of energy transmutation.

The fall of an apple to the earth is a sensible phenomenon, of which the force of gravitation is a theoretical explanation. In like manner the phosphorescence of the vacuum tube is a phe-

nomenal fact, of which the kathode rays and shower of ions are an hypothetical explanation.

With such instrumentary concepts metaphysics has nothing to do. But metaphysics is entitled to say that postulating the actuality of sense in all its infinite variety, as discovered and displayed in observation, and postulating also the reality of energy—a quantifiable entity constantly transmuting in definite ratios and under definite forms—science, with ever-increasing completeness, offers a harmonious and self-consistent scheme of the whole of our experience.

That the great principle of ever-transmuting energy was present to the mind of Aristotle seems very clear. But it failed to gain acceptance with his successors; it altogether failed to impress itself in specific and identical form upon the minds of his successors in the same field of inquiry.

Leibniz and many others have represented Aristotle as holding to the *tabula rasa* view of the mind, and maintaining that knowledge was supplied to the intelligence *ab extra* by the impression of sensible particulars. The maxim, *nihil est in intellectu quod non fuit in sensu*, is laid to his charge.

Leibniz's famous rider, *nisi Intellectus ipse*, was his reply to the use made of this principle in the hands of Locke. He discerned the element of truth in the Platonic doctrine of substantial forms, an element to which his emendation was intended to give due effect. But it rather appears as if in this respect he, and indeed many other commentators

on Aristotle in consequence of their failure to appreciate his great distinction between the potential and the actual, have unjustly or at least unwarrantably classed him with the phenomenalists, when in reality his metaphysic contained the very principle needed to reconcile the contradictions and remove the difficulties of realism.[1]

The decay of Greek philosophy may be blamed for this result, but it is more probable that in the then state of physical knowledge no other could have been anticipated.

Not until Leibniz, by his ever-memorable demonstration of the true measure of a moving force, established a definite quantifiable ratio between potent reality and its phenomenal result was the way paved for the full and definite apprehension of the truth. Not until the principle of its indestructibility was made capable of definite determination by quantification was it possible to affirm the reality of that which we momentarily recognise as power. Not until we are in a position to co-relate and unify the power which we know subjectively in

[1] *καὶ αὐτὸς δὲ νοῦς νοητὸς ἔστιν ὥσπερ τὰ νοητὰ ἐπὶ μὲν γὰρ τῶν ἄνευ ὕλης τὸ αὐτό ἐστι τὸ νοοῦν καὶ τὸ νοούμενον.*

De Anima, lib. iii. cap. v. The terms of this passage remind us how far Aristotle was from sensationism. The things *ἄνευ ὕλης* are pure ideas, in short, the Activity of Thought. When Thought represents to itself its own pure Activity, then the act and the object of Thought are identified. But when Thought represents the energetic process of Nature in which the Ideal is blended with and expressed in the sensible, then and in that case the contrast between Thought and Existence stands out emphatic. *ὁ νοῦς ἐστὶ περὶ τὰς ἀρχὰς τῶν νοητῶν καὶ τῶν ὄντων.* *Mag. Mor.* i. 35.

our own exertions with the power of which nature and natural law are the exercise and the manifestation, was it possible to find in this postulate of science a key to the meaning of the affirmative judgment by which the mind constantly systematises into knowledge the mutable panorama of experience.

XXI

THE FORM OF SPACE

We may perhaps still be asked whether in terms of such a postulate we have been able to explain the necessity with which spatial form seems to be imposed upon our cognitions of Nature.

It has been already pointed out that spatial form, tridimensionality, qualifies the phenomena of massive materiality. It obviously does not qualify the activity of thought, nor, indeed, does it qualify at all many of the classes of sensible phenomena. In themselves, sounds are not spatially conditioned. The same is true of chemical and physiological changes. It happens, however, as we have frequently pointed out, that the phenomena of mobile masses are the condition precedent to organic existence, and hence constitute the primary datum of sensible experience.

It is for this reason, and for this reason alone, that tridimensionality appears to be *for us* fundamental. But, even so, tridimensionality is undoubtedly dependent simply upon the particular law of energy transmutation which determines massive materiality.

All scientific explanation is in essence a theory which accounts for individual sensible experience in terms of an objective physical transaction or operation which is independent of the conscious individual subject. Massive materiality is explicable in terms of a natural force, the action of which varies inversely with the square of its distance from the point of origin. Now it can be easily proved that *any force* which acts *uniformly* within tridimensional space must obey this dynamical law, and that simply because the areas of spheres are proportional to the squares of their radii. That is how we state the matter from the standpoint of phenomenal observation, but, of course, from the standpoint of energy transmutation the proposition must be correspondingly inverted. A force is the measure of the rate of a transmutation of energy. A given rate of transmutation determines the measurement of the force which is its phenomenal expression. It is obviously in accordance with and in obedience to the rate and the form of the transmutation in which it consists that massive materiality acquires its form of tridimensionality. The uniform transmutation of energy at a given rate from one given form to another necessarily involves as its phenomenal expression a particular form of force, of which tridimensional materiality is the necessary phenomenal result.

Given a variation in the rate and form of transmutation, and the phenomenal condition of tridimensionality no longer results.

If gravity is correctly conceived as an emanation from a centre acting uniformly and universally in tridimensional space, it *must* vary inversely as the square of the distance. It was for this reason that La Place long ago suggested that gravity was, therefore, a necessary quality of matter. He would at least have been entitled to say that if materiality is a phenomenon which is determined by a process of energy transmutation of which such a force is the expression, it must as a consequence possess the characteristics of tridimensionality.

But although the above is the accepted theory of the action of gravitating masses, it must not be forgotten that it is, after all, an hypothesis. We are not, therefore, entitled as a matter of strictly logical scientific deduction to found thereon the conclusion that there is a necessary causal nexus between gravity and tridimensionality. Gravity might possibly not act as a uniform emanation. On certain theories it has been held only to act where material masses are interposed. Indeed there is no *a priori* reason why it should not be regarded (as it was by Descartes) as a force or pressure from without urging bodies towards a centre rather than as a force of attraction drawing them inwards.

Newton was well aware of the simple mathematical proposition that the areas of spheres are proportional to the squares of their radii, from which the law of the inverse square necessarily results. And he was also aware from his own observations that the force theoretically necessary to explain the

deflection of the moon in her orbit was less than the force of gravity at the earth's surface in the inverse proportion to the squares of the radii of the earth and the lunar orbit respectively. But he was careful not to base his demonstration of the law of gravity on the fact merely that if gravity were a uniform emanation outwards, that was the exact proportion by which it ought to be diminished in intensity at the distance of the moon's orbit. Newton, in point of fact, founded his theory upon a sure mathematical basis by demonstrating, firstly, that any body urged towards a centre by a force directed thereto must describe about that centre equal areas in equal times, and therefore, conversely, that as Kepler had established the fact that the planetary radius-vector did describe equal areas in equal times, the force under which the planets were controlled in their orbits *must* be directed towards a focus of the ellipse, and, consequently, that whatever hypothesis may be formed of the action of such a force, *if* it varies inversely as the square of the radius, any two spherical masses mutually affected by such an influence *must* each be deflected into an orbit concave towards the other and *must* describe one about the other regarded as fixed, or both about their common centre of gravity curves, the forms of which are limited to those known to geometry as conic sections;—the particular circumstances of each case as regards distance and direction, etc., determining which of the conic sections—whether a circle, an ellipse,

a parabola, or a hyperbola—the orbit in question must necessarily assume.

It was on this sure basis of mathematical certainty that Newton founded his dynamical explanation of the motions of the heavenly bodies as ascertained and described in Kepler's famous laws. On this same basis alone we are safely entitled to proceed in our argument. So proceeding, we find that Newton's demonstration immediately entitles us to say that whatever hypothesis of the nature of gravity may be ultimately found to be valid, or, indeed, apart from any hypothesis as to the ultimate explanation of its action, there is a necessary relation between the continuous action of the force which, varying inversely to the square of the orbit's radius, retains the moon and the planets in their orbits and the geometrical forms which continuous change of direction of motion within tridimensional space must assume. So far, therefore, as regards the forms which Matter in motion assumes under the action of a constant force, they are ascribable to the same potent activity which determines tridimensionality. When the force is not constant we may have, of course, an infinity of indefinite forms which we cannot or at least have not yet been able to classify. But the elements of physical forms are ascertained in the study of natural forces. Resistance is discovered in our activity, and the forms of the resistant opponent, as so discovered, have a common origin with the forms of our free activity itself. That resistant opponent,

we must ever try to remember, is not a thing but a process—a change which a thing undergoes. The tensions of the physical system which determine the phenomena of materiality determine also and at the same time the possible forms of motor Activity, and these combined constitute tridimensional space.

Tridimensionality is the creature and sensible form of a potent kinesis which determines alike the features of resistant materiality and of motional change.

XXII

THE DEFINITIONS OF MATTER

The accurate definition of Matter, as well as of certain of our other elementary concepts, has long been a stumbling-block with scientific writers.

In his essay on *Matter and Energy* the present writer many years ago pointed out the obvious contradictions and inconsistencies which characterised some of these definitions. For example, one definition favoured by Tait described Matter as "that which can be perceived by the senses." It was easy to show that such a definition was inapplicable to what claimed to be a *real thing*, the main constituents of sensation being transmutations of Energy. Another definition suggested by the same author was "that which can be acted upon by or can exert force." This definition seems to be free from the charges of inconsistency, but it in no way implies the *reality* of Matter. Indeed, only by avoiding any such affirmation can consistency be secured.

The writer has not deemed it necessary to elaborate the foregoing line of argument in his

present Essay. The inadequacy and inconsistency of the idea that three-dimensioned body is real has long been recognised and affirmed by metaphysicians of almost every school, and it seems no longer needful to press the point even upon those interested in Science. The idea has only been tolerated even by these latter because of the difficulty of finding a substitute.

The remarkable achievements of Physics have apparently suggested to some that Science does not require to trouble itself about its definitions ; that these belong to the effete logomachies of the past.

But this cannot be allowed. Science is the co-ordinated system of human knowledge about Nature. It is essential that this body of thought should be clear and definite. In point of fact no one recognises this more clearly than the principal physicians themselves. None are more careful than they with the definitions of their working conceptions. None know better the importance of clear and accurate thinking in such matters. If Science has got on without clear definitions of Matter it is because the instrumentary concepts of Physics are dynamical. Professor Tait, who found it so difficult to define Matter, was most exacting in demanding accurate conceptions of Energy and Force.

For Science, Matter is not really an instrumentary conception.

The various aspects of the "material" are separately studied and defined whenever their employment is necessary. Yet the impression that reality

consists of three-dimensioned sensible bodies has been a distinct hindrance to the progress of Science. Scientifically it is quite unfruitful. Physics progressed originally as a study of Force. Its recent and great advances have been accomplished by aid of the concept of Energy.

We sometimes hear the question raised—Will this concept of Energy last? Will it endure as an instrument of scientific thought? Lately, in certain scientific quarters, there have been suggestions of a return to a corpuscular theory of Light, to the caloric theory of Heat, and so on.

It may well be that phenomena which were supposed to be fully explained in terms of kinetic Energy are found to require further elucidation. It may be that phenomena lately conceived as undulations in a fluid may be better understood when conceived as motions of minute masses. It is for the man of Science to decide.

But nothing of that sort can remove the contradictions which involve any theory which asserts that the objects of sensation as they appear to sense are at the same time independently existing things; nothing of that sort can affect the fact that our cognition of the external is derived from our exertional activity, that the postulate of Reason is potency, and that it is in terms of this postulate that we must ultimately explain our whole experience of the external. Nor, we may be sure, will any such developments require or allow the physician to supersede the concept of an ever-transmuting

Energy as the sustainer of the phenomenal by the really unthinkable hypothesis of a sensible substratum.

A reflective savage from Patagonia suddenly transported to, and placed in, a railway train running through a forest might attempt to explain his experience as a rushing stream of trees. A break in the forest might lead him to seek a better key in a rapid succession of telegraph poles and wires. Each of these is an actual phenomenon. Each, too, has a real relation with the real operation to which his experience is due. Careful observation of each will yield facts and data which will afford a real knowledge, however imperfect, of that operation. In each case he is groping for the apprehension of the real energetic process. Yet how much fuller, how absolutely different does his knowledge become when the whole dynamic action of the train is fully made known and understood.

In this crude simile may we not figure to ourselves the course of man's endeavour to explain and understand the infinite activities of Nature?

XXIII

THE RELATIVITY OF DYNAMICAL KNOWLEDGE

THE primary elementary concepts of which the Science of Dynamics is constructed are Space with its implications, Motion, Mass, Force, and Time. Of these, Mass, Force, and Time are the concepts peculiar to this Science; and it is a remarkable fact that no one of these can be estimated or computed without reference to the others.

Take the concept of Mass. Mass is usually defined as quantity of Matter. Now even assuming that we are agreed as to the identification or definition of Matter, how are we to proceed to determine its quantity? The spatial measurement of bulk gives a definite result, but the validity of such a test of Mass depends not only on the estimation of density, but also upon the assumption of absolute chemical and molecular uniformity,—of neither of which do we possess any certain and perfect test—certainly at least dynamical Science does not possess such a test.

But in point of fact, quantity of Matter or Mass is measured and estimated by reference to Force. The

idea of mass arises out of the experiences of our exertional activity, and hence our elementary test of resistance and of mass is exertional, and our definition of the material is ultimately and fundamentally dynamical. Two bodies are said to be of the same mass if the same force acting during the same time produces in each the same acceleration. But how, then, are we to estimate Force? Equal forces are defined as those which produce equal velocities in equal masses. But velocity, again, involves time; and how do we measure time? Assuming Newton's First Law, and also assuming the possibility of ascertaining equality of Force, we reach the conclusion that equal displacements record the lapse of equal intervals of time. But these assumptions involve the possibility of measuring Force. Our knowledge of time is entirely derived from our experience of the dynamic world process. But for the periodic motions of the Earth we should have no knowledge of day and night or summer and winter—indeed we should have no idea of the flight of time. But for the pendulum, the sand-glass, or some other adaptation of the action of gravitating masses we should have no instrument for the measurement of the shorter conventional intervals of time. But for the operation of Natural Force we should have no concept or idea of time at all, and no means of estimating its quantity.

Before we can make any progress we must assume the continuous uniformity of Natural Force. We say that equal forces are those which produce equal

accelerations in equal intervals of time. Assuming that the Force of Gravity is constant and non-selective, this affords us a standard for the measurement of time. But suppose the force of gravity to vary. Bodies would fall faster or more slowly, but the pendulum's oscillation would be correspondingly varied. We should be obliged to invoke a reference to another form of force, such as that exhibited in the uncoiling of a spring, to enable us to measure the variation of gravity, and the uniformity of such force could again only be maintained by measurements which involved the assumption of continuity. We see, therefore, that without assumptions we cannot estimate Mass, Force, or Time except by reference to each other.

The true secret of the assurance we feel of the truth of dynamical principles is to be found in the fact that, postulating the laws of dynamic action formulated by Newton, we find we can explain the operations of Nature with accuracy and consistency.

"It is," said Clerk Maxwell, "when we come to define equal forces as those which produce equal rates of acceleration in the same mass and equal masses as these we are equally accelerated by equal forces, that we find that these definitions of equality amount to the assertion of the physical truth that the comparison of quantities of matter by the forces required to produce in them a given acceleration, is a method which always leads to consistent results whatever be the absolute values of the forces and the accelerations" (*Matter and Motion*, art. c.).

Now at the basis of our assurance that this consistent system accurately expresses natural operations lies the experience afforded by our exertional activity. It is hence that the primary concept of dynamic impulse is derived.

The conviction that change of motion involves the exertion of Force is as much fundamental and *a priori* as the most certain of geometrical truths. It is, indeed, necessary to resort to experiment and observation to ascertain how far this principle can explain the multifarious stresses of the environment. But so far as Impulse is homogeneous with that which determines our own activity the certainty of the principle, though it is a certainty derived from experience, may be described as absolute.

Dr. C. G. Knott observes: "It is easy to convince ourselves that increase in the speed of a body requires the action of Force." But he goes on: "It is not so demonstrably evident that a decrease in the speed of a body requires the action of Force, and that the constancy of the velocity of a body means that there is no effective force acting. All this, however, is a legitimate inference from our experience. The more completely we get rid of all known resistances to motion the less evident is the diminution in the speed of the moving body. Moreover, in the motions of the planets and satellites astronomy gives an object-lesson in which resistances due to motion play an altogether insignificant rôle. The forces which are all-important are those due to position. Their effects can be calculated long before-

hand, and in the agreement between the observed and the predicted configuration of the solar system, at any instant we find the complete justification for the principle just stated."[1] We see thus how the concepts of pure Dynamics have been arrived at. We begin with the fact of exertion giving rise to motion. We then isolate this conception from its sensible accompaniments. Until that is done, it might be contended that the exertional experience of a living being subjectively considered seems to suggest that motion has a natural tendency to cease and die away. The great achievement of Galileo, Newton, and the other founders of dynamical science was to isolate the concept of Force—as the objective aspect of sensible resistance—and thus to lay the foundation of dynamical science;—and indeed we may say to furnish the exemplar and type of all scientific knowledge properly so called.

And the Science of Dynamics thus founded is not less pure than Geometry itself. The demonstrations of its theories, granting the requisite postulates, are not dependent on measurement, and are not mere approximations. It is the extent of their application to the world beyond us which stands in need of constant verification. Dynamics owes its extension, the definition of its limits and the realisation of its implications, to the labours of observation and experiment upon which physical science is based. But the principles thus applied are theoretically pure and abstract. None the less

[1] *Knott's Physics*, p. 40.

should we always remember that the origins of the Science are laid in our exertional activity; that the concept of the Mass-Vector as distinct from the vector of transference is supplied by and derived from the experiences of our exertional activity, and from these alone; and that it is to these that in the last resort we must refer for the suggestion of the homogeneity of impactive and positional forces. But, activity not being measurable by intuition, we seem to be left with this result: that our system of dynamical knowledge is a system absolutely consistent with itself—the objective truth of which is supported by an ever-increasing and to us almost absolutely perfect series of verifications, but is still theoretically a body of knowledge sustained by data which mutually sustain themselves.

It is quite otherwise with regard to space. No doubt it is by reference to bodies that we know and measure spaces. But bodies in this connection are treated merely as rigid constancies of form without any dynamical importance. And such spaces and resistances can be compared and measured by reference to the organism or some other member of the same class without reference to any of the other concepts of dynamics.

This unique characteristic of spatial concepts is attributable to the fact that they are generated by our own free exertional activity, considered apart from the stresses involved in living amidst our environment. It is for this reason that the

spatial datum is, so to say, self-contained, whilst all concepts which are derived from our experience of a stress necessarily involve interrelations and interdependence.

But now the remarkable thing to be next noted is that this basal or fundamental concept, although obviously derived from our exertional experience, and therefore and thus related to and rooted in the real, is at the same time the great framework of the phenomenal. For although the unreflecting man is always apt, for the reasons just indicated, to regard space as in very truth the most absolute of cognisable realities, it is impossible for a reflective person not to realise that that cannot be true. Even were the former to satisfy the obvious obligation incumbent upon him to determine whether the space which he regards as real is of two dimensions or of three, and were he to say that the concept suggested by exertion was tridimensional, he still cannot overlook the fact that the tridimensional itself is but one particular case of the general condition of externality.

How is it, then, that that concept by which we conceive the phenomenal should seem to be self-contained and independent, whilst those which express the relations of what we have endeavoured to exhibit as the very essence of reality should be incapable of more than a purely relative estimation? Surely the answer must be found in the fact that the transmutation of reality, not reality itself, is our immediate datum; that, as we have

so often indicated, the real is a potency constantly in process of mutation, that the actual is the transmutation of the real—necessarily derived, therefore, from that of which it is the transmutation, yet absolutely opposed to and contrasted with the Real and Self-subsistent.

Tridimensional space, as we now believe, is but the form of a particular transmutation of Energy, but it constitutes for our Cognition the basal point of reference. It marks that stage in the infinite progress at which we find ourselves and from which we start.

"There are," says Clerk Maxwell, "no landmarks in Space. One portion of Space is exactly like any other portion, so that we cannot tell where we are. We are, as it were, on an unruffled sea, without stars, compass, soundings, wind, or tide, and we cannot tell in what direction we are going. We have no log which we can cast out to take a dead reckoning by. We may compute our rate of motion with respect to the neighbouring bodies, but we do not know how these bodies may be moving in Space" (*Matter and Motion*, art. cii.).

That is all very true, but then there seems to be at least one thing which we can say of our relation to this unruffled sea. We can tell surely that we are on its surface; that that is the stage at which the immeasurable and infinite process of change happens to have reached when we appear, and from which, as our inevitable and necessary starting-point, we may commence our endeavours to fathom its

depths even if we may never hope to map its shores.

Does it then follow, after all, that our dynamical knowledge is essentially relative, and that we have been deluding ourselves in expecting to obtain through the instrumentality of dynamical Science a key to the true nature of reality, and, if not, how is it that such clue is obtainable?

We reply that the secret was found when it was discovered that the true scientific view was to regard phenomena as links in a chain of progress, as balanced operations which can at any stage be estimated in terms of a postulated power adequate to sustain them; that, in short, a phenomenon rightly studied could be made to divulge at one and the same time the power which produced it and the power which by a further mutation could give actuality to its successor. The great problem is to find that which sustains and determines the actual. If there is anywhere Reality it must be something of which phenomena are but transmutations and which amidst these transmutations remains undiminished in quantity. Not only so, but it must be in virtue of its presence and potency that these transmutations occur.

Knowledge dynamical, then, is rightly called relative, not absolute. But it is relative to the Knower, to the standpoint provided by his consciousness and activity, by reference to which it is measured and estimated, and thus, and thus only, can it—albeit relative—become Knowledge of all.

The real, *for knowledge*, is only just that which can produce the phenomenal. Whatever other qualities or characters it in itself may have—and they may be infinite and inconceivable—to us it is nothing but the potency which determines its own constant mutations and thus generates the presentation of sense. The true test of its quantity, therefore, is to be found in the work it can do.

To extricate this fact from the changing phenomenal scene should surely take us at last into the presence-chamber of Reality. And this is just the result which, after three centuries of patient labour, Physical Science has accomplished and now offers to a too reluctant Metaphysic.

But for the danger which the discovery threatens to the long-cherished idols of the cave, this revelation of the metaphenomenal should surely have been welcomed by all sections of reflective thinkers.

Not only is it the most important contribution of Science to Metaphysics, but it is at the same time the completion of the main structure of physical knowledge which owes its power to the unconscious recognition of the dual aspect of sensible experience, as presenting to sensation the phenomena of sense and at the same time to knowledge the laws and forms of an energetic process.

XXIV

THE TWO ACTIVITIES OF THE ORGANISM AGAIN DISTINGUISHED

We have already contrasted the two activities of the organism—thought and exertion. We have already noted the marked differences which distinguish them. We have already seen that the recognition of these two activities affords a key to the theory of knowledge as a representative function.

We are now in a position to find in these two activities a key to the two great categories of the transcendental æsthetic. For we find in their universal forms the simulacra of our old friends, the categories of time and space.

To begin with the latter, we find that our dynamic activity transacts itself within the sphere or subject to the conditions of tridimensionality. Body and motor activity are conditioned by space; but these conditions of activity which we call space, as they exist for us, are characterised by the quality of tridimensionality. This we now know is the result or expression of the particular form of

energy transmutation in virtue of which massive materiality becomes a phenomenon,—the free mobility of body being necessarily also conditioned by the same qualifications. It is in the exercise of such free mobility that the qualities or rather the essential forms of materiality are discovered.

Tridimensionality, then, is obviously the universal form of *our* dynamic activity.

It is equally clear that the activity of thought is not limited to, though it is capable of representing, vector activity, but is naturally applied to express other relations and magnitudes purely scalar. This is why it has been so often said that Thought has for its universal form what we call time. Time has been described as undimensioned or of one dimension only. Dimension in its application to thought is not strictly comparable with dimension as discovered in sense, but, in point of fact, the activity of thought as it admits both coexistence and succession would be more properly described as duodimensional, and might be figured by the illustration of a uniformly moving plane.

We should have then (1) the activity of thought —duodimensional and temporal, and (2) the activity of exertion amidst mobile masses, which is tridimensional, and which we in its more limited sense call spatial.

In point of fact, however, the notion of time could not develop apart from our exertional activity. Without the periodicity which characterises the motion of mass in tridimensional space we

should have no means of measuring time. Under the influence of the constantly acting forces of Nature the constant accelerations involved induce a curvilinear form and thus establish periodicity. This periodicity of physical change necessitates and establishes the periodic functions of the vital organism.[1] Apart, therefore, from dynamic action, time quite as much as space would be not only incommensurable but altogether absent as a condition of pure noematical activity if such were in these circumstances possible.

The facts of memory prove that we are really present at all periods of our conscious life. We say we recollect a past event; we recognise the mental picture as similar to or identical with the past event. But we could never do so unless the past event were still present in some way to enable the comparison to be effected. And so it is. From the past as from the present it is only an infinitesimal fraction of reality which is submitted to cognition. But it is all there. All that we see, however remote we deem it, is in the eye; all that we have experienced, however long the interval which seems to have elapsed, is somehow with us now. Succession, like extensity, is phenomenal only. And such instrumental conceptions would necessarily pass away if we could imagine that state of perfect kinesis in

[1] The two great periodicities which affect Life are the rotation of the Earth on its axis and its revolution round the Sun. To these apparently correspond the two classes of living organisms, the animal and the vegetal, the former having evidently been determined by the periodicity of day and night, the latter by that of the seasons.

which knowledge and reality should be made one in which all that is potential could have fully evolved and expressed itself in actuality.

It is therefore more correct to describe the Activity of Thought as unlimited by the vectorial character of direction, and as adapted to the expression either of scalar or of vectorial magnitudes. Although strangely enough its original data are derived from and furnished by exertional vectorial activities, still its proper activity is independent of these limitations which it constantly strives to transcend.

We have therefore (1) the *pure* Activity of Thought, either (*a*) logical, qualitative, ratiocinative, or (*b*) mathematical, quantitative, scalar; and (2) the *representative* Activity of Thought—imaginative, intuitive, quasi-vectorial—by means of which we represent and interpret the dynamic Activity of the organism and of its environment. The latter is the earlier and simpler in the history of individual experience—for all Cognition is based on the dynamic foundation.

Corresponding, then, to these two forms of activity by which our knowledge is constituted and determined, we have two corresponding forms of apriority. We have (1) the apriority of thought, and (2) the apriority of motor activity. These correspond to what Leibniz intended by (1) the law of contradiction or identity—the scholastic *dictum de omni et nullo*, and (2) the principle of sufficient reason—subsequently so much beloved of Schopenhauer.

The former is limited only by its own capability. The law of contradiction is therefore the appropriate rule of its determination and furnishes us with logical apriority.

The knowledge of spatial qualities, the science of geometry, is also equally entitled to the title of apriority which has been so long accorded it. And for this reason, that it is the universal form of our normal organic activity. And as an expression of our own activity it is known by deduction. It is studied in, discovered from, and demonstrated by our own organic action. Its laws are wholly contained within the organism. They can be learned and can only be learned therefrom, and that without any appeal to the extra-organic. For us, therefore, they are necessary and universal, and of apodeictic truth.

It is true that tridimensionality does not express the form of all energy transmutation. It does not determine the activity of thought, and in thought it is quite possible to conceive and mathematically calculate the conditions of a space, if so we should call it, of some other dimensional degree. None the less is the geometry of our space for us as organic beings a necessary and universal science.

There need be no alarm, then, lest in our journey through space we shall suddenly pass, as some speculators have feared, into space of four or five dimensions, or that any part of the space in which our physical system seems to be contained may be such that in it a triangle may contain less or

more than two right angles, or any other similar catastrophe. Such a cataclysmic experience if it does occur will involve no such voyage. It will engulf us at our anchorage; for it will be brought about not by *a journey within* tridimensional space, but by an alteration in those laws of energy transmutation by which our present organism is determined.

XXV

THE AXIOMS OF GEOMETRY

Interest in the problem of the nature of the concept of space has been enlarged by the advance in the Science of Meta-Geometry. We have to refer merely to the bearing of these investigations on the nature of knowledge.

Meta-geometry is frequently described as projective geometry, because by an extension of the method described as projection it provides for the study of generalised spatial conditions irrespective of the limitations of tridimensionality.

We are familiar with the idea of projection as a means of presenting a spatial form of given dimensions in terms of one of some other dimensional degree. Just as uniform circular motion is represented on a straight line as a simple harmonic vibration, or just as the sphericity of a globe is presented in our world maps on a plane surface, so by what may be regarded as an extension of the same method we are supplied with the means of studying space apart from the limitations of tridimensionality. Of course the real subject of study in meta-geometry

is the general form of energy transmutation of which the tridimensional is a particular case.

The origin of meta-geometrical inquiry is to be found in the famous difficulty which has so long disturbed mathematicians in Euclid's demonstration of the properties of parallel lines. And when the true clue to that difficulty is ascertained, the real import of the investigations of meta-geometry on the theory of knowledge becomes very clear. Once more, the key is to be found in the recognition of the fact that all geometries are sciences of the forms of activity;—Euclidean geometry of the form of *our* organic activity, which is fundamental and necessary for us, although now, in view of the results of such inquiries, evidently seen not to be, therefore also universal and necessary for any of the other possible forms of energy transmutation.

Euclid in these latter days has fallen on evil times. A number of critics have put forward the view that his immortal treatise is unsystematic and unscientific, and they have boldly offered substitutes for which greater perfection is claimed. These strictures are unwarranted, and arise from the unphilosophical habit of the critics concerned.

Certain meta-geometers live constantly in fear, or shall we say in hope, that observations of some stellar parallax may yet disprove the truth of Euclidean propositions;—may, for example, yield a triangle the sum of whose angles is less or more than two right angles. They seem to forget that all physical observation occurs necessarily at the

point where the energetic transmutation which affects the organism occurs. How it can escape the laws of its own being they do not venture to tell. Others, zealous of continuity, have devoted their efforts to proving, for example, that all right angles are equal,—in other words, that the term right angle always has the same meaning. It is impossible. The conceptual act presupposes the continuity of the energetic process in which tridimensionality consists and by which the organ of cognition is determined. Otherwise Language has no meaning. Granting this postulate the proposition is an identical one, and is incapable of demonstration. On the contrary hypothesis it is without meaning, and is neither true nor false.

Euclidean Geometry is a presentation by our noematical activity of the forms of our free exertional activity. It starts, therefore, with certain axioms or self-evident rules or maxims of pure thought, which, with the exception of the so-called axiom of parallel lines, are purely logical principles dealing with scalar magnitudes only. They are the laws of thought, of noematical activity —specially applicable to this science. They affirm the relations of equality, greater and less, all of which are ascertainable by the simple act of comparison without the necessity of measurement or quantification by means of the interposition of any sensible standard of reference. (The last three axioms are really postulates, and were so classed by Euclid.) The experimental method of ascer-

taining quantity by reference to a standard or sensible medium, which is the method of physical observation, necessarily involves a loss of apodeictic purity, although there is a corresponding gain in inductive efficiency. All such sensible estimation is inapplicable to a pure or deductive Science, and is rigidly excluded by Euclid. The method of superposition, which he not infrequently employs, is no exception to this rule, but in strict compliance with it; and his use of this method illustrates the rigid fidelity with which he adhered to his principle. Superposition is a method of immediate comparison, and allows of ideal or theoretical purity both in the application and in the result. It is only when the intervention of a third sensible standard is resorted to that ideal purity is sacrificed and sensible or physical estimation takes its place.

Having enunciated the axiomatic, *logical*, scalar principles applicable to the study of exertional forms, Euclid next proceeds to postulate and define the *exertional* conditions which yield these forms.

Directed motion is the fundamental requisite. Directed motions and changes of directed motions are therefore the most general postulates. Directed motions are visually represented by lines, changes of directed motions by angles or curves. To draw a straight line in any direction is therefore the first postulate. An angle represents an abrupt or isolated change. Continuous change is represented by circular motion, and Euclid, therefore, postulates

the power to draw a circle from any centre with any radius.

The other definite and regular curvilinear forms of the dynamic system are what are known as the conic sections. A cone is, in point of fact, formed by the rotation of a triangle. Euclid was acquainted with the various conic sections as derived from cones produced by the rotation of triangles, right angled, obtuse, or acute. He does not appear to have discovered the derivation of these curves from the section of a rectangular cone by the simple expedient of varying the inclination of the cutting plane—a discovery usually attributed to Apollonius. But for our non-mathematical purpose it is sufficient to note that the elementary postulates of his system are derived from the natural forms of *human organic* activity.

Euclid thus, with a perfect symmetry of treatment, starts (1) with his noematical axioms or logical common notions dependent for their self-evidence on our intellectual activity, and (2) he postulates and defines the necessary forms of our exertional activity. Thus equipped, he proceeds to develop his science or representative statement of the principles and forms of our free exertional action.

The axiom of parallel lines appears to stand out as a very marked exception to the symmetry of this scheme. It is obviously not axiomatic—not a logical necessity of thought—as are the other axioms. It is, indeed, altogether different from them, dealing as it does with a vectorial, not with a scalar,

relation, as all the proper axioms necessarily do; and indeed it seems certain that Euclid did not propose to place it amongst the axioms.

It is, however, a very important and significant proposition. Whether Euclid realised its implications cannot be ascertained. For long his successors did not. The axiom in one word may be said to postulate tridimensionality as a condition of Euclidean geometry. It affirms the rectangularity of space. Understood and acknowledged as such, its position at the commencement of Euclidean geometry becomes perfectly consistent. But it should have had a place by itself as a statement of the limitations or conditions-precedent of his Geometry—or been stated as a general proposition introductory to the postulates and definitions. The difficulties which have grown up around it, and which led ultimately to the development of metageometry, are due to the fact that it is obviously not what it was expected to be, namely, an axiomatic law of thought; whilst nevertheless it is evidently true, at least for the spatial conditions governing our environment. It is, in short, exertionally necessary but not logically or noematically necessary.

The confusion arose from overlooking the difference between logical apriority and exertional apriority. The exertional data of Geometry are contained in the postulates and definitions which should therefore have been expressed in terms capable of realisation by our organic activity. And in every case they *are* so expressed with one single exception. The

exception is the *definition* of parallels. In that one single case Euclid failed to state his proposition in a form which was capable of being developed and proved from the data of our organic activity. In all other respects his geometry is entirely a development of the forms of our own exertional activity expressed in their most general scope. Thus we postulate a power to draw any straight line in any direction or to describe any circle from any centre with any radius. The particulars of locality and dimension are indifferent. But our potency is still always limited by its own capabilities. The actual accomplishment of the infinite is beyond its power. Euclid's demonstrations of the geometrical properties of parallels are vitiated by the fact that *in his definition* of parallels he exceeds the possibilities of our exertional power, and it is in the effort to redeem this fault that he resorts to the proposition known as the 12th Axiom.

Euclid in the 27th and 28th Propositions proves that if a transversal cuts two straight lines and makes the internal angles equal to two right angles, and the alternate angles and the exterior and opposite interior angles equal, these lines are parallel. This he does negatively. If not parallel they must meet. Let them meet at a point. That is a construction possible to our activity, and the construction being made, it is easily shown that it involves a contradiction. Such lines, therefore, cannot meet, and are accordingly parallel within his definition.

He thus establishes a universal affirmative pro-

position: All lines which, being cut by a transversal, have alternate angles equal, etc. etc., are lines which never meet. From which by conversion a particular affirmative necessarily follows. Some lines which never meet are lines which, when cut by a transversal, etc., have their internal angles equal, etc. But to prove from a merely axiomatic basis the universal converse of the first proposition, namely, that all lines which never meet are lines which, when cut, etc., has been found impossible. The efforts of mathematicians for two thousand years have been directed to achieve it, but in vain. We can describe the necessary figure, assume the given lines to be parallel, and by a similar negative argument to that employed in the former case; if the angles are not equal, postulate and describe the required construction. We obtain thus a third line possibly cutting one of the parallels and *ex hypothesi* parallel to the other, but we cannot prove any necessary inconsistency between the assumed parallelism of the original lines and the hypothetical inequality of the angles. Logically on Euclid's data both lines might be parallel to the third line even although intersecting.

Euclid got over the difficulty by the assumption of the 12th axiom, but the root and origin of the difficulty lies *in his definition*. It cannot be put to the test of actuality. We cannot produce the two lines to infinity; yet a *positive prolongation* to infinity is required.

We saw that Euclid postulated the power to draw a

line in any direction. He postulated, that is to say, the capacity of free mobility in its most general form. But it is one thing to be unlimited and unrestricted. So much *ex hypothesi* is granted to our free mobility. The actual positive accomplishment of infinite prolongation is an altogether different matter. If our potency could construct and our intellect could apprehend lines which actually did extend to infinity, we could prove the 29th Proposition without any axiom at all. We have no difficulty in proving the 27th and 28th Propositions by postulating and constructing the negation of such infinite production.

That this is the source of the difficulty is evidently seen by the fact that the demonstration presents no difficulty if only parallel lines are defined in accordance with the capabilities of our organic potency; and parallels may be and have been so defined. Prolongation to infinity is not of the essence of the conception. Indeed it is not the most general expression of the concept. The idea involved is that of constant equidistance, a principle which applies to the parallelism of, *e.g.*, concentric circles as well as of continuous straight lines. We might, then, define parallel straight lines simply as lines which are always at the same distance from each other. This was the definition suggested by Albert Dürer in 1525. Of it Playfair remarks that "it was adopted by Wolfius, Boscovitch, and others, and ingeniously but, perhaps, undesignedly involves a new axiom of a straight line, namely, the possibility of it always

keeping at the same distance from another straight line."

This objection is, however, unfounded. True, the actual construction of parallel lines does involve the possibility of one line remaining always at the same distance from another. But the first postulate had already covered this demand, which is equally imperative whatever definition we may adopt. The definition in question, however, does not require the concession of any such actual or exertional possibility. Definition does not involve exertional possibility. You can define many a figure which is impossible of actuality. Make your definition, and experience will show if it is realisable. This objection, therefore, is seen to be based on a misconception of the distinction between the two degrees of possibility. Another objection to the definition which has been greatly insisted in is that it involves the idea of distance, which is said to be a metrical quality, and to involve measurement, and therefore to be inadmissible. Now it is true that distance does involve measurement, but, strange as it may appear, the ascertainment of equidistance does not. In that particular case the fact can be ascertained by the direct method of superposition without the intervention of any third instrumentary standard, and without, therefore, any appeal to the unpurified data of sensible measurement. This objection also, therefore, falls to the ground.

The definition, however, might, if preferred, be stated in the following terms :—

"Parallel lines are lines in one plane such that the shortest line from any point in one or in that one produced to the other or the other produced is in every case equal to the shortest line from any other point in either line to the other line." Granting such a definition, which would be in accordance with what we have seen to be the true origin of geometrical ideas as representative of the pure forms of our organic activity, it will be found quite easy to prove the truth of Euclid's 29th Proposition without any appeal to the objectionable axiom.

To accomplish this we merely require two auxiliary propositions.

In the first place, we require a theorem corollary to Proposition 12 of the first book as follows :—

If from any point without a given straight line of unlimited length a straight line be drawn perpendicular to the given straight line, such perpendicular is shorter than any other straight line which can be drawn from the given point to the given straight line. The simple demonstration is, of course, based on Proposition 18.

In the second place, we must complete the theory of triangles by supplying, after Proposition 26, the corresponding Proposition applicable to the case of a triangle with two sides and one angle other than the contained angle equal.

As is well known, universal equality cannot be inferred from these data. Todhunter gives the demonstrable proposition as follows: "If two triangles have two sides of the one equal to two

sides of the other, each to each, and the angles opposite to a pair of equal sides equal, then if the angles opposite to the other pair of equal sides be both acute or both obtuse, or if one of them be a right angle, the two triangles are equal in all respects."

We may call this Proposition 26*a*. It may be limited to right-angled triangles as follows: "Proposition 26*a*. If in any two *right-angled* triangles one of the sides containing the right angle and the hypoteneuse are equal, then the triangles are equal in every respect." The demonstration is simple.

Having premised these Propositions, we can prove Proposition 27 as follows: From the points where the transversal cuts each of the two lines which are to be proved parallel we draw perpendiculars to the other line. We thus obtain two triangles having two angles in one equal to two in the other, and the transversal between the points of intersection is their common base. It follows (Prop. 26) that the triangles are equal; therefore that the perpendiculars are equal, and therefore that the lines are parallel.

We need not give the corresponding demonstration of Propositions 28 and 29. The latter, of course, follows from Proposition 26*a*, as enunciated above.

In this way, more elaborately than by the rough and ready assumption of the 12th Axiom, but not more gradually and minutely than other geometrical propositions are established by Euclid, we can arrive

at a demonstration of the theory of parallels from the pure data of the true postulates and axioms.

We have done this whilst limiting our axioms to purely self-evident laws of thought and our postulates and definitions to the general forms of our exertional activity.

Tridimensional space, we are told, can be treated as of three different kinds. It may be regarded as affected by what is metaphorically denominated a curvature, either positive (spherical) or negative (pseudo-spherical). Or it may be treated as flat (homaloidal). To this latter alone does Euclidean geometry apply. It alone, therefore, is the space of which our exertional activity gives us an intuitive knowledge. It is from this that its necessary and *a priori* truth for our cognitive experience is derived.

XXVI

THE STRUCTURE OF THE ORGANISM

THE theory of knowledge which we have presented as the true deduction from the facts of experience finds a confirmation in the structure of the organism.

We have said that knowledge is in essence an Activity, that it is constituted by and consists in the affirmative activity of Thought—of which, as we shall presently see, the cerebrum is the organic instrument. But we have also seen that the forms of this activity are determined, that its materials, if we may so say, are furnished by our exertional activities with their resulting accompaniment of sensation—which it is the primary function of the affirmative judgment to represent. These exertional dynamic activities are functions of the organism, but they are discovered to us *ab extra* by the stresses resulting from the limitations and opposition of their environment. To us, therefore, that limiting environment is actual, and serves as the constant indicator of the real. It is from these data that the Activity of Thought derives its form and its subject-matter. Their representation

is the useful object towards which it is directed. And the fact that affirmation is thus and thence supplied with a predicate accounts for and explains the prevalence of the popular but imperfect view which regards knowledge as a receptive rather than a representative or affirmative process.

But whilst the primary materials of Cognition are thus derived from exertional data, cognition is still an activity distinct from the activity of exertion; and although its operation is always qualified and so far determined by the source which originally stimulates its action, it nevertheless possesses the power and capacity of self-expression beyond that of mere representation; in particular it can transcend the limits which the environment sets to muscular effort. Pure noematical activity, although its operation is always qualified by the forms of exertional activity, transcends these forms. In conceiving the Abstract, the Ideal, the Infinite, it proceeds untrammelled by the conditions of tridimensionality which limit and determine musculo-motor action. But the basis of intellective activity must still be the exertional activity of the organism.

The study of cognition, volition, and emotion as organic functions was prosecuted with great ability and originality by the late Dr. W. B. Carpenter, who thus became one of the founders of that department of investigation which illustrates the activity of Thought by reference to organic function. His conclusions were very clearly stated in his

well-known *Principles of Mental Physiology*, and to this work we still refer, because the exposition of the fundamental and elementary relations between the organism and its activities is unconcerned with the results of recent experimental Psychology, and because Carpenter was one of the first to recognise the dynamic basis of cognition. In a passage which the writer has often quoted he says: "In fact, instead of Matter, as some affirm, being the object of our immediate cognisance, and the Laws of Matter our most certain form of knowledge, there seems valid ground for the assertion that our notion of Matter is a conception of the Intellect, Force being that externality with which we have the most direct, perhaps even the only direct, cognisance. And in this way Force, of the existence of which we are rendered cognisant by the direct testimony of our consciousness, which is to us the most certain of realities, comes into immediate relation with Mind."

Dr. Carpenter uses Force—and there is plenty of good precedent for such use—as a generic term covering both energy and the stresses which its transmutations involve, indeed everything potent. Properly, however, these must be distinguished. With the late Professor Tait this was a favourite theme. Force in strictly dynamic terminology is now usually applied, as he insisted, to the ratio of transmutation. It is the rate of change of momentum—as in a statement of the force of gravity or such-like. It was not within Dr. Carpenter's province

to make this discrimination, nor did he deal at all with the metaphysical implications of his statement. He did not quite reach the position that the idea of Matter is itself capable of reduction to dynamical terms. But he recorded his conviction that in studying the functions of the organism in relation to our experience as sentient, cognitive, and volitional, potency, not materiality, was the proper and necessary postulate.

In like manner he recognised that it was from exertion that the ideas of power, force, and causation were derived. Along with Sir John Herschell, Dr. J. D. Morell, M. Maine de Biran, and others, he recognised that Causation is no mere statement of sequences, that dynamics is no mere equation of configuration ratios, but that in every case the distinct idea of potency is involved, and is for us derived from our own exertional activity.

All activities objectively considered are energetic transmutations. There is the energetic transmutation in which materiality consists—the condition precedent to organic existence. Then there are the molecular activities of the organism, to which a similar remark applies. These, of course, are conditions precedent to organic existence, and cannot be objects of immediate cognition.

When we come to those superinduced vectorial activities called usually material motions, there are amœboid movements, movements of cilia and movements of muscles. As regards the first and second of these, there are no organs instrumentary

to the transmission of the results of their activity to the centre of organic consciousness. We are limited, therefore, in immediate cognition to the musculo-motional activities of the organism, *i.e.* to the functions which as an organised unit it is adapted to perform.

It is in these alone that our intelligible experience consists, and with these only, therefore, is knowledge concerned. Even if *experience* should be held to include the instinctive and functional organic activities, *knowledge* is nevertheless necessarily limited by the forms of those Activities which react upon the instrument of Cognition.

Keeping these considerations in view, let us now notice shortly how the structure of our organic functions corresponds to the constitution of our cognitive activity.

The organism as a unit comprises (1) those organs which maintain the functions of the life of nourishment, and growth—of the *vegetal* life, as it is called; (2) the organs of sensibility and locomotion—the instruments of *animal* life proper; (3) the organs of Thought and Speech—the instruments of *rational* or intellective life. The classification is as old as Aristotle, and is unimprovable to-day.

(1) The vegetal life, despite differences, may be said to be common to all living organisms, both vegetable and animal. The organs of this form of activity in the simpler classes of animals operate without the instrumentality of any, or at least of any definite system of innervation. But as we

ascend in the scale we gradually find a nervous system developed for their control. That system in the human organism controls the *purely internal* activities of nourishment, such as digestion, circulation of the blood, etc. No doubt from their very nature these functions depend upon a communication between the organism and its environment. Organic life of every kind involves such intercommunication. But in the higher forms of life, where the division and differentiation of function is more marked, the special activity of the organs of vegetal life may be described as internal or self-contained within the organism. By itself this activity does not involve conflict and contrast between organism and environment. The duty of securing nourishment from without devolves upon another part of the organism, and the organs in question are devoted to the work of assimilation and growth.

The action of these organs, then, affords no suggestion of objectivity and cannot furnish any contribution to knowledge. We are not including their relationship with emotion, to be presently referred to. But as regards knowledge, these activities do not enter into the constitution of the affirmative judgment. We have no direct knowledge of the nutritive processes by which the organism's supply of Energy is maintained. They are not reported to the cerebrum. We get glimpses —but glimpses merely—of these when the body enters into perception *ab extra*. We see or feel an

occasional pulse-beat. But the ordinary normal nutritive processes are not directly cognised. The requisite nervous apparatus is absent. Our knowledge of these functions of the organism is derived *ab extra* by observation of the phenomena of the action of other organisms in our environment. Knowledge, indeed consciousness in the sense in which the word is usually employed—certainly self-consciousness—is wanting in all purely vegetal life. And in like manner the vegetal portion of animal activity furnishes no direct or immediate contribution to knowledge.

Such contribution commences with the development of (2) the *purely animal* functions — those functions which specially distinguish the animal from the vegetal—the functions, namely, of locomotion and sensibility, in short, *of exertional activity and its limitations.*

These are the functions concerned on the one hand with the motions of the organism's own mass amidst its environment, and on the other hand with the discovery of the stresses involved in their interaction.

Locomotion and sensibility are interdependent. This has hardly been sufficiently realised. It has, indeed, been well observed that locomotion responds to sensible stimulus, but hardly as well that sensation is dependent equally on locomotive activity. Yet so it is.

Locomotion is an activity within the dynamic system of mobile masses, in which natural forces

are constantly operative. For this reason all locomotion involves exertion or work, and here accordingly the environing opponent is discovered.

The correspondence between sensibility and locomotion is established in two main stages of directness.

a. Afferent and excitant nerves issue in pairs from the spinal column, and an *immediate* response is there established between the ordinary sensation of Touch and a locomotive stimulus transmitted by the corresponding excitor nerve. At this stage there may not even be sensation. Sensation proper—actual feeling—seems only to arise when the inward stimulus is transmitted to the sensorium or central ganglionic tract at the base of the skull. Hence the appropriateness of the term excito-motor for this primary co-ordination.

b. The higher stage of co-ordination is reached when the sensible stimulus is transmitted to the central ganglia of the sensorium, from which by excitor nerves a more complex and more fully co-ordinated locomotor stimulus may proceed. It is at this stage that the co-ordination takes place between the special sensations of Sight, Hearing, etc., and motor activity. And this co-ordination of the various classes of sensations constitutes what Aristotle referred to by the term κοινὴ αἴσθησις—common sense.

The sensorium is the seat of this co-ordination, and is the common point of origin of the nerves of the special senses as well as the ultimate terminus

of the afferent and excitant nerves of Touch and Motion. Here is the real seat of sentient consciousness or sensation, properly so called—which neither extends downwards to the immediate reflex response between the afferent and excitant in the spinal column, nor upwards to the higher nervous activity of the cerebral hemispheres. The cerebrum itself is without sensation.

The co-ordinations above described are independent of any stimulation from the cerebral hemispheres, and are therefore reflex and automatic. They constitute the largest class of activities which characterise the action of the animal species. These functions are hereditary and transmissible, and in the individual they therefore appear in a degree of completeness which proves their entire independence of individual experience or intelligent volition. The instinctive co-ordination of vision and action evidenced in a newly-fledged chicken's almost perfect capacity for judging distance within certain limits is an often-quoted instance.

These automatic and *instinctive* activities attain their highest perfection in the articulata. In the marvellous instincts of the social insects, such as the bee, they reach their fullest development and attain a perfection to which they never arrive in the vertebrate series. But however perfectly such instinctive and automatic activities may develop, they in themselves involve nothing of the nature of cognition. They furnish the materials of which

knowledge makes use, but they do not themselves generate knowledge.

(3) In the third place we have the cerebrum, which is the organ of a quite distinct Activity —the Activity of Thought. But then Physiology tells us that in the organism of the vertebrata the co-ordinations of Activity which are effected at the sensorium may be reported to the cerebrum.

Nerves, sometimes called the nerves of the internal sense, maintain a communication both afferent and excitor between the cerebrum and the sensorium. In this way sensible impressions which, if not transmitted beyond the sensorium, would merely be represented by a sensation and would merely stimulate an automatic motor activity may be further transmitted to the cerebrum, and may thus furnish the materials of an ideative cognition of the external. It is in such ideative representation or affirmation, thus stimulated, that *cognition* fundamentally consists. On the other hand, the activity of the cerebrum may, by the excitor nerves of the internal sense, be communicated to the sensorium and become thus the author of that deliberative ideomotive activity by which the actions of rational man are distinguished from the reflex and automatic actions of the less intelligent orders—in fact of deliberate *volition*.

Yet again an impulse transmitted from the cerebral system may affect even the sympathetic system which regulates the activity of purely vegetal life; may qualify the feelings which accom-

pany such activity and which in themselves are merely sensual and appetitive, and may so raise them to the level and platform of *emotion*.

In this way the whole organic life is transfigured by its immediate participation in the intellective ideative activity, which is the highest function of the human organism.

The gradual development in the vertebrates of this communication between the sensorium and the cerebrum is accompanied by a corresponding evolution of the faculty of cognition. Such faculty is, however, greatly extended when it is at length accompanied by a special instrument of expression, the faculty of language and speech. This is found only in man, and this it is which constitutes his highest attainment and marks in him the appearance in action of the faculty of Reason with all its capacities and possibilities.

The cerebral hemispheres, then, are the organs of ideative Activity—which includes both Thought or Rational and Imaginative Discourse and ideomotive activity, or what is usually called "deliberate Volition."

To the independent activity of the cerebrum we ascribe (*a*) the *re*-presentation of the activity of exertion, which constitutes the fundamental—the vectorial—element in Knowledge; (*b*) the pure noematical activity of the rational and imaginative human being. The latter, indeed both of these, are dependent on the development of the faculty or function of Language as the instrument of their

expression. Noematical activity, like every other form of human action, is dependent for its development upon the provision of an instrument appropriate for its exercise. If we desire to develop any faculty or capacity we supply it with the appropriate instrument. If we wish to teach writing we give the child a pen; if digging, a spade; if music, a piano; and in like manner the development of rational discourse is dependent upon the possession of the appropriate instrument—speech. Equipped in this way, man has developed his marvellous faculties of Reason and Imagination and purposive action, of which speech is the instrument and the cerebrum the operative organ.

Thus we find that the structure of the organism confirms the view that Cognition is a function entirely other than sensation, and is served by an organic instrument which is peculiarly liberated and protected from physical stresses, yet is capable both passively to apprehend and actively to influence the dynamic activity of the organism and its environment.

Cerebral activity being unlimited by and unconditioned by the stresses of the environment, is free also from the restraints of such limitations.

It is in the exercise of this activity and of it alone that man can develop the ideative activity of Discourse, can exercise Reason and Imagination, can set up Ideals, and can even conceive the Infinite, albeit only negatively.

In the nature of cerebral activity, as unqualified

by the limitations of sense, we understand also how Reason and Discourse acquire their character of ideality; how the sentence, The horse draws the cart, can have a clear and definite meaning without our being obliged to frame any mental picture either of a horse or of a cart, or to determine whether the horse is white or black, brown or bay, or what sort of carriage is put in motion by its efforts.

It is then evident that cerebral activity is adapted to represent, though it is not confined to representing, the dynamic process; and in such representative activity the object is not sensation but motor activity. Thoughts, or Ideas, as Plato called them, when they represent the process of reality, do not do so by reproducing in fainter form the fleeting sensations which are the mere accompaniments of the obstruction of motor activity. What cerebral activity does is to reproduce or rather represent the dynamic activity in which sensation arises.

This is the truth which underlies what Plato intended by affirming the reality of Ideas. This is what Knowledge accomplishes, and this is why Knowledge can accomplish anything and why Science is possible to man.

And as noematical activity expresses the forms of dynamic action, we see why it is that the line, the triangle, and the circle are not pictures or copies of sensations but expressions of activity. Such ideality is characteristic of all Science and not merely of logical or geometrical knowledge. Necessity and universality for us are limited to those forms which

are contained within and derived from our own activity, but Ideality is common to all sorts of knowledge.

The apparent apriority of geometrical knowledge is due to the fact that it expresses the forms of our own organic exertional activity, which are the universal and necessary conditions for us of our cognition of the object world of which the organism is a part, and which, *as it is a part of the dynamic system*, expresses also the universal form of that system—that is to say, of our material world.[1]

But a higher form of apriority characterises the operations of the cerebral activity itself. Such activity being limited only by the capabilities of its own potency, submits only to the law of contradiction and to no other extraneous barrier. The recognition of the two degrees of apriority explains the correspondent gradations of conceivability about which men have puzzled so much.

By the mere juxtaposition of words we can state propositions which are incapable of being conceived in Thought at all; *e.g.* we can say a thing both is and is not at the same time, but we

[1] The proposition that two lines cannot enclose a space is for us self-evident, and its apprehension is called intuitive. The proposition that oxygen unites with hydrogen in the proportion of eight to one is said to be inductive and only ascertainable *a posteriori*. But the intuitive character of the former proposition is due to the fact that it is necessarily implied in the exercise of our organic activity. If that activity necessarily involved the combination of oxygen and hydrogen, then the law and ratio of that chemical change would be for beings so constituted as necessary and self-evident as the most fundamental axiom of geometry is for us to-day.

cannot in thought conceive it. But again, there are ideas and propositions which are quite conceivable in pure thought but inconceivable when thought represents the organic process of Nature. We can thus conceive without attempting to represent even where representation is possible. We can think of a triangle without limiting ourselves either to one equilateral, isosceles or scalene; or, again, we can discourse of a regular polyhedron with seven plane faces, though when we proceed to representation we find that such a figure is impossible within the limits set by tridimensionality. There are thus two degrees of conceivability corresponding to the limits of pure thought and the narrower limits set to Reason when it is applied to the data of our exertional activity.

It sometimes seems as if all deductions from physiological data involve a manifest *petitio principii*. In spite of all your destructive theories, we are told, you deduce them from a study of the motions of the material molecules and atoms whose reality you profess to deny. And in the case of many a doctrine the criticism has unanswerable force. But it loses all relevancy when we realise that the phenomena of sensible actuality, subjectively regarded, are but changes in the sensory portion of the organism.[1] They express

[1] It is remarkable how tenaciously the physician often clings to the reality of his atom and molecule. But if he admit that the sensible is phenomenal he must do so throughout. Mere size can make no difference here.

in their variety the form and features of the real physical process. Indeed they are for us the only instrument of its discovery; but it is the real kinesis which is the object of Knowledge.

XXVII

WHAT WE KNOW

It is often said that one-half of mankind does not know how the other half lives. We pass through life, we mingle amidst the activities of our fellows, and yet we know but the merest fraction of what they do. We depend upon the sailor, the miner, the weaver, the miller even for the necessaries of life, yet to the details of their labours we are strangers. Each lives in a world the workings of which are very foreign to his fellowmen.

But more nearly associated with us than these are the workings of our own body. The whole process of our organic functions is to most of us almost wholly, and to all of us largely, unknown.

The microscope reveals a whole world of organisms and processes in full activity around us, but of which without its disclosures we should not even dream.

We think we see the stars. We invent the telescope, and we find ourselves spectators of the mountains of the moon with their craters and their valleys, of the rings of Saturn and the restless

satellites of Jupiter. But the telescope immediately discovers to us nothing except motional changes occurring in our own eyes. It does not even produce or originate these. The radiant undulations whose impact on the retina constitutes the visual sensations which we describe as the mountains of the moon, were going on there just the same before the telescope was introduced.

An infinity of potent influences and transmutations is constantly proceeding with remarkable harmony at the single point in space where the visual organ happens to be—nay at all the innumerable points of space where visual organs are—where they either are or may be.

The knowledge of man appears thus to be wide and varied, but it comprehends only an infinitesimal fraction of the knowable, and such fraction consists entirely of what his own intellective activity comprehends.

Knowledge, too, we must ever remember, is limited to the representative Activity of our cerebral organs. Feeling is not knowledge. It is altogether futile to describe it as a mental state. Consciousness, sensibility, receptivity may have far wider implications. Knowledge, again, does not include Instinct, which is not a cerebral function. To say that All exists in virtue of being known by the Absolute, so far from being the grandest of philosophic generalisations is the narrowest, based as it is on an exaggerated anthropomorphic hypostasis of knowledge as the one Reality in the Universe,

an opinion the affirmation of which increases not the greatness of the thinker who propounds it, but the greatness of the space which separates his Thought from Fact.

Berkeley and the idealists of his school asserted that sensations are non-existent unless when perceived, and so far as concerns the sensation subjectively regarded the statement is clearly true. But to assert that no real event, no dynamic transmutation, is proceeding irrespective of our perception, is what no one believes or can believe, and any philosophy which maintains such a position is evidently false. But the error consists in forgetting that the object is in essence not a complex of sensations but a dynamic operation.

It is by intellective action that knowledge conceives reality for us, but it does so by participation with the dynamic process. Its dependence on the dynamic, so far from destroying or weakening, *creates* the ideality of knowledge. Without such a fulcrum the community of knowledge would have no foundation, the affirmative judgment no existence, and truth no meaning.

The dynamics of mobile masses, as expounded in the seventeenth century by Newton and the other originators of physical science, were followed by the first beginnings of the idea that sensation consists in mutation. There seemed to remain an immense unresolved residuum of unintelligible sensation, blurred, vague, and undifferentiated. As science has progressed this mass has been gradually

reduced to a related system. Heat, light, sound are now conceived as different forms of energy, and all the varieties of sensible data are thus explained.

If there are still left certain classes of unquantified and unrelated sensations, such as those of taste and smell or our internal organic feelings, of these we at least know enough to be quite sure that they, too, are but energetic transmutations, and that if the more complex and less periodic laws upon which they depend (or at least the laws the periodicity of whose operation is less known to us) could be ascertained, they, too, would be completely explicable in terms of energy change.

Sensation, we know, is but the subjective aspect of energetic mutation. It only arises when in some way the vital organic activity is interrupted. The real process which science studies is continuous and incessant. The electric current vibrating darkly along the narrow confines of the wire suddenly expands at the carbon point into the radiant undulations which illumine a city. So it is with sensation. Its impressive prominence is always dependent on an unseen energetic activity.

Speaking in reference to time, what we feel is only what is *actually* occurring at the point where sentient consciousness is active. Yet the facts of memory prove that the whole past is always present somewhere. But for the fact that the system of energetic transmutation which constitutes cohesive materiality is a permanent condition of our organic

existence, and that it involves rotation under the influence of constant natural force and therefore periodicity, Duration would be not only unknown and unknowable, but would have no objective basis at all.

Just as we have found that spatial perceptions, however extensive, are located at a point, so must we acknowledge that, in terms of the absolute, experience is timeless too.

Our whole knowledge of the universe of space and time, be that universe unlimited or merely vast, is clearly, therefore, intellective and inferential. None the less is it true that in knowledge, thought and thing must be ever contrasted, that cognition must be arranged and differentiated under the relations usually called Space and Time, that the separation of Knowledge and Reality is a necessity of our imperfect state, and its recognition, therefore, an inevitable requisite of Truth.

La Place in his *Exposition du Système du Monde*,[1] in referring to the law of the inverse square, draws attention to its implications as follows: "A remarkable property of this law of Nature is that if the dimensions of all bodies in this universe, their mutual distances and velocities, were augmented or diminished proportionally they would describe curves entirely similar to those they describe, and their appearances (apparances) would be exactly the same; for the forces which animate them being proportional to the masses divided by the

[1] *Livre* iv, cp. xviii, p. 345, Tom. xvi.

square of the distance will augment or diminish proportionally with the dimensions of the new universe. We see at the same time that this property pertains only to the law of Nature. Thus the appearances of the motions of the universe are independent of its absolute dimensions as they are also of the absolute movement which it may have in space, and we can observe and know only ratios. This law gives to spheres the property of attracting each other as if their masses were condensed in their centres."

In a word, the ascertained laws of energetic transmutation involve the dynamical relativity of Space and Time, which are the quantifying ratios, but not at all the categorical continent of Experience. The antinomies of temporal succession, the dilemmas of Zeno, disappear when we envisage the fact that the energetic transmutation is in essence timeless and inextensive.

XXVIII

SCIENCE AND REALITY

Men in all ages have endeavoured to relate the sensible world of touch and vision with the unseen world of Causation and Power. Religion in all its forms is an attempt to accomplish this co-relation, and science by a very different method seeks to accomplish the same end. The elements of knowledge are the forms of action. Science is knowledge systematised.

Logic, grammar, and geometry deal with the subject's unrestricted activities—Logic with the fundamental laws of thought, that is of cerebral activity; grammar with the forms in which that activity is expressed in speech. Geometry, as we have seen, is the science of the laws and forms of the free mobility of the organism as a mass discovered in and by its energetic activity. When thus understood, such sciences as Logic and Grammar are seen to be no longer barren and unfruitful, but quite as useful both educationally and practically as others now more popular. Similarly the sciences of enumeration — Arithmetic, Algebra, Calculus

deal with the activities of thought in reference to quantity; though it may be doubted whether the idea of quantity could arise at all apart from the experience of dynamic stresses.

Dynamics is the science which deals with the operation of Force. Obviously our definition applies to it. And it is equally obvious that it applies to Chemistry, Optics, Acoustics, Thermotics.

We have not mentioned Astronomy, so evident is it that a survey of the starry constellations is merely auxiliary to the theory of their periodic motions.

Nor is our definition less obviously true of Physiology. It applies also to all the so-called morphological Sciences. Those organs of the form of which they treat are studied with reference to their function, that is their form of action. In all branches of medical science the truly skilful man is he who rightly conceives the processes which are in progress in the organism and which determine its condition. Mineralogy became a science when the true law of the classification of crystals was understood, to wit the angle of crystallisation. But that again is simply the form of action by which the shape of the crystal is determined. Geology is meaningless until we understand the process by which and in virtue of which the strata have been laid down. The geologist as he surveys the mountain conceives of the energetic process by which its form was given; not less when he contemplates the peaceful valley is he conceiving the slow processes

of denudation and depositation which shaped its contours.

As regards the zoologic sciences, the plant and animal are both organisms developing certain activities, and they can only be classified in terms of their organic functions.

The so-called moral sciences—ethics, law, and history—deal professedly with those activities of mankind which express the collective operation of man's intellectual and emotional nature. Just so the industrial and practical arts, such as agriculture, navigation, architecture, and so forth, describe the laws of his collective activity when directed to the primary end of maintaining the organic life of the individual.

What is true of science is in this respect true also of art; for art is but knowledge applied to human needs, whether merely the needs of nourishment and organic life or the needs of our higher cerebral activity.

Both involve the understanding of the means required to effect a purpose. What is the meaning of the notable word understanding? To understand a thing is to know it as you only can if you stand under it; ascertain not merely its appearance, but the process of activity by which that appearance is produced, in short, how it works. That tells us its real nature.

We hear a great deal about the definition of a thing—about its concept and about the meaning of the concept.

What is a definition? What is a meaning? Anything can be described and so far identified by reference to the relation in which it stands to my own action. This, indeed, has been suggested as the true test of Reality. "A Thing," we are told by the Pragmatist, "is that which enables me to satisfy my active impulse."

A railway train on this principle may be defined as that which enables me to travel from Rome to Paris, a potato as that which enables me to satisfy my feeling of hunger. Such definitions at least help to prove that it is not by its sensible accompaniments that we define a thing.

But they are not scientific definitions. The difference between common knowledge and science properly so called is just the difference of standpoint. Whilst the former conceives of things as they affect the individual Knower, science proper conceives them from what we may call the physio-centric standpoint, having regard to their place not in the economy of the individual's requirements but in that of Nature as a whole.

If there is no such standard, knowledge is impossible, and we are obliged to fall back upon sensation and can define nothing.

Recent theories of reality, which define it by reference to individual needs, are merely an echo of doctrines expounded in the *Theœtetus*; or of the sophist Gorgias, who might be fairly claimed as the first and original Pragmatist; although they are given forth with a solemnity and an air of novelty

which at least testify to the despair of their advocates.

The true criterion of reality is dynamic. Whatever the standard from which it is regarded, whether from that of the individual or from that of Nature, the true definition of anything is a statement of its dynamic potencies. Such a definition must tell us how to make it, or how Nature makes it, and what it can do. Any other definitions are but symbols, marks, indicators of the thing. It is because there *is* a dynamic system, a world of transmuting energy, that knowledge is possible, and the constituents of knowledge accordingly are determined and located by reference thereto.

Of late years it has been given forth as the last word of Philosophy that after all there is nothing more real than the immediate—the actual—and that on each fact of the presentation the mind confers its appropriate degree of reality, however changeable and evanescent such presentation may be. A sound which suggests a lion's roar is really fearsome, if it causes fear;—although it may proceed from some entirely harmless source.

The doctrine testifies to the constant conviction that the actuality of the sensible, as every man instinctively recognises, is the true key to reality. But it ignores, on the other hand, the essential difference between the actual and the real. Thinkers oscillate between the two alternatives in a helpless inability to reconcile them. And reality, they after all conclude, is simply an attribute awarded to the actual

experience in respect of the efficiency of its relations to our desires or to our needs. But such an explanation is vain. The mind's belief does not constitute reality. On the contrary, just exactly to be independent of the feeling and of the belief of any subject—that it is to be real.

We only believe in that which we believe to be independent of our belief.

And only by the postulate of an ever-transmuting potent energy, the transmutations of which (in themselves mere changes) constitute the actuality of sense, can we solve at once the dual difficulty.

The shelves of an ancient theological library crowded with venerable volumes seem to surround us as we write. Innumerable problems are discussed at immense length with profound learning and elaborate scholarship. Propositions are demonstrated after the most complete inquiry and with the most rigid logic, yet whole systems of Thought and Truth therein contained are universally recognised to-day to be valueless and vain.

It is little different with many a philosophic system founded by a thinker of originality and elaborated by the patient studies of numberless faithful disciples. To them everything seemed real and evident and final.

The conditions of the voluminous metaphysical discussions of to-day are not very hopeful, and bear a remarkable resemblance to their theological predecessors. Dissatisfied with the speculations of the past, without a guiding clue to the future, they

oscillate in a vain eclecticism from Hegelianism to Pragmatism, from Idealism to Empiricism, and obscure the reality of the perennial problem in a fantastic novelty of phrase. Sometimes in futile redundancy they seem to lose themselves amidst "the concrete riches of immediacy." Sometimes in the affectation of over simplicity they seek repose for the restless "functioning" of their speculative activity in the "thisness" and "thatness" of the "here" and the "now." If so many systems are gone and have become meaningless, what hope that any other will succeed where they have failed?

The triumph of Science is the great objective encouragement. It affords at least one example of success. And it offers the only clue to another. And that clue is to conceive of things in terms of their organic potency.

As Schopenhauer well remarks: "All depends on the source whence you derive your conception; if it be taken from experience, all well and good, for in this case its object exists and needs no further proof; if, on the contrary, it has been hatched in your own sinciput, all its predicates are of no avail, for it is a mere phantasm."

And as Kant said, speaking of Plato—

"Just in the same way did Plato, abandoning the world of sense because of the narrow limits it sets to the understanding, venture upon the wings of ideas beyond it into the void space of pure intellect. He did not reflect that he made no real

progress by all his efforts, for he met with no resistance which might serve him for a support, as it were, whereon to rest, and on which he might apply his powers in order to let the intellect acquire momentum for its progress."

Metaphysics has, indeed, made little progress since the day when Aristotle died.[1] Not that we would suggest for a moment that the immense discussion which the perennial problem has received at the hands of the Nominalists and the Realists of the Middle Ages, and between the Idealists and Intellectualists on the one hand, and the Phenomenalists and Agnostics on the other hand, in more modern times has been of no value. For it has surely at least established the negative result that without another key than that furnished either by Intellect or by Sense it is impossible to unlock the double door which bars the entrance to the inner shrine of Reality.

[1] It is true that after the death of Plato the problem of knowledge was much canvassed in the Athenian Academy. That sensation cannot afford a real knowledge seems to have been recognised. But an attempt was made to distinguish between a simple impression and one derived from a perambulation of the object. The latter—called *περιωδευμένη φαντασία*—was thought to afford a greater certitude. Somewhat similarly Lord Haldane tells us, when the sunset glowing on the distant hilltop makes it seem to be on fire, it is *if we go to it* that we find it is not really burning. Here we find a clear recognition of the influence of our activity in the construction of knowledge. Yet such a view still clings to the idea that the datum is an impression of sense. It has not realised that the content of cognition is a reproduction of the forms of action of which sensations and phantasms are but the breaks, the turnings, and the fringe.

In achieving this result it has laid the foundation of the new advance, but that advance has only become possible in consequence of the new conception of potent Energy by which science at length has unified our knowledge of Nature.

XXIX

NATURE AND ART

An endless war has been waged as to the true relation between Nature and Art.

Art, says one school, is the humble servant, the obedient follower, of Nature. Its highest privilege is faithfully and patiently to reproduce every detail which Nature furnishes. Art, says the other school, cannot subsist on mere acts of imitation. The blind and servile copyist without imagination or originality is no artist at all. The contradiction disappears when it is realised that Nature is a dynamic process, and that the thought and imagination by which it is conceived and known is an activity also. Art does demand the most absolute fidelity to, and the most patient study of, Nature; but it is of Nature so conceived and understood. The mere copyist of the sensible impression, who has never realised the inner potency of things, in all his blind and dreary labour can never reach the truth, can never apprehend the meaning and the power of Nature or of Man. His utmost efforts are vain.

To reach by inference from its sensible effects the

potent cause which sustains them is the work of Reason; to reproduce, from the postulates to which reason leads up, the spirit of the scene, to re-enact the drama of natural activity, is the high achievement of Imagination. Ruskin felt the truth of such a view. He protested against the word æsthetic on the ground that Art is not in essence a reproduction of the sensible, but an expression of its spirit. And he proposed the term theoretic as the name of the faculty by which the meaning and the spirit of Nature are artistically conceived.

What is this faculty of theoria but the imaginative cognition of the potent activity which sustains and enlivens the sensible world?

The only arts which should be directly mimetic are those in which action is immediately reproduced as action—the art, for example, of the actor *par excellence*, as he is very properly called. It is the very art of which the perfection consists in the perfection of the mimetic faculty. The highest acting implies sympathetic imaginative comprehension, but it is still in essence necessarily mimetic. And it is a sure proof of the spurious actor that he constantly endeavours to conceal the weakness of his mimetic gift by elaboration of scenery, and perhaps also by a fraudulent affectation of intellectuality.

XXX

ETHICS

BUT Ruskin said that Theoria was a faculty of moral perception.

The Moral Sciences are pre-eminently sciences of activity. That is recognised at once and on all hands. Wherein, then, lies the difference between the moral and the physical? Fundamentally it lies in the recognition of ideo-motive action. Cerebral activity may, as we have seen, stimulate and originate either action or feeling, and when so originated they are ascribed respectively to volition and emotion.

The superior dignity of volition and emotion to instinct and appetite is a primary and universal conviction. But the reason is not so readily seen. It is by the distinctive character due to ideo-motive impulses that instinct and appetite are transformed into Volition and Emotion. It is in the recognition of this transformation that the ethical fundamentally consists. It is in a projection of our own highest principle of action that we are led to postulate a moral supremacy in the world around. All the

great ethical religions—the Jewish, the Christian, the Mahometan—inculcate as their fundamental tenet a belief in one God. But the principle of the distinction between them and the heathen and naturalistic faiths is not merely numerical.

The many gods of polytheism personify with imaginative fidelity the variety of natural powers. But in calling them all gods polytheism acknowledges the homogeneity and ultimate unity of Power.

The essential characteristic of the ethical religions is to be found in the fact that they do not merely personify the power of Nature, but express the recognition of an activity distinct from and superior to the dynamic. Originally begotten, as may well be supposed, of the consciousness of such an activity in man himself, those faiths proclaim that a like but infinitely greater Potency ultimately controls, or at least presides over, the physical and the organic. They teach that there is a Being who may be invoked to regulate the moral activities of man and to redress the inequalities with which the dynamic activities of Nature restrain the free exercise of Volition. They appeal under the name of conscience to our innate conviction of the superior claims of the Ideal; and they offer to redeem the hopes which the Ideal awakens in the human heart from the disappointments to which these hopes are doomed by the relentless and irrevocable processes of the physical world. For these dynamic activities, always tending to undifferentiated uniformity, threaten the Ideal with a prospect of ex-

tinction against which the unlimited capabilities of ideative activity perpetually rebel.

In elevating the Ideal to an independence of the dynamic, they suggest that such independence should raise it even above the most inexorable of natural laws. They claim for the soul or Ideal Activity an immortal destiny which robs the grave of its victory and Death of its victim.

They appeal to the endless Beauty of Nature, to the evidence of design in Nature, to the Inexplicable in Nature, to the Mystery of Nature, as proofs of the doctrine which holds that throughout the Universe the supernatural prevails over the natural. Against such a view the advance of Science is claimed as resulting in the gradual conquest of the mysterious, and in the substitution of evolutionary adaptation for supernatural design. But the pathway which such advances appears to have opened out to Metaphysics rather points to the suggestion that both supernatural and natural energies are ultimately but two forms of one universal Potency—that ideative not less than exertional activity is the expression of a form of the action of what by men is most appropriately named Omnipotence.

XXXI

THE SCIENCE OF LANGUAGE

THE foregoing chapters were written with the object of presenting a sketch or summary of the arguments in support of that theory of human knowledge which regards it as essentially an organic activity, primarily expressive and representative of the organic activity of Exertion.

And they were designed as preliminary to what was intended to be our main thesis, namely, an explanation of the corroboration which such a theory derives from the nature of Language.

Yet we find that this, our main thesis, when we come to submit it, does not seem to require more than a very brief statement.

The activity of thought, from the very fact of its isolation and its independence of the stresses of the physical environment, stands in need of an instrument for its expression and not less for its communication.

The instrument is supplied in the exertional activity of speech—an activity marvellously adapted in various ways to accomplish the purpose and object for which it is employed.

Speech is an activity of the organism which encounters the environing opponent in the form of the circumambient air, and which effects its object, namely, the production of audible sensations, by originating undulations in that ever-present and all-enveloping medium. An activity which encounters the external in this form is practically unaffected by dynamic stresses, and is for this reason peculiarly adapted to express and reproduce in all their infinite variety the self-contained activities of thought.

It is therefore evident that an analysis of the forms of language — the natural expression of thought — should discover to us with peculiar simplicity and directness the essential characters of discourse. Such an analysis has been made for us by the greatest master of the science of language, the late Professor Max Müller, and we find it unnecessary to do much more than record the main results of his inquiry. Their application to the theory of knowledge will be evident without any elaborate argument.

In his analysis of language Professor Max Müller soon brings us to the ultimate or radical elements —properly designated "roots." Roots are the monosyllabic elementary forms out of which all the variations and inflections of spoken language are derived and constructed.

"We have now to face the final question, What are these roots? If we can answer that," says Professor Max Müller, "we shall know what language is." His answer is threefold.

"All roots which we find in English, in Sanskrit, or, rather, in that stratum of language which lies even beneath Sanskrit, are *perfectly definite in sound.* Their consonants are guttural, dental, or labial, surd, sonant, or aspirated. These consonants can be modified according to certain rules, but they are not vague and indefinite, as is often the case with the vowels and consonants of less developed languages.

"Secondly, they *nearly all express acts*, such as bearing, striking, pushing, cutting, tearing. And you will find if you trace even the most abstract and elevated notions back to their original source that they are borrowed from such material concepts as tearing, pushing, and all the rest. *Abstract*, for instance, is what is torn away; *Elevated*, what is pushed aloft.

"Thirdly, *they are all conceptual*, that is to say, they do not express a single percept—as, for instance, the sound of cuckoo, or moo, or ba—but they signify *acts*, or qualities conceived as *the result of acts.* Percept, as you know, is the technical name given to our cognisance of a single object actually perceived by the senses; while concept is the technical term for our cognisance of something common to several objects which can never by itself be perceived by the senses. Thus snow is called a percept; the white of snow a concept.

"When logicians ask how we came to form concepts, they seem to see no difficulty whatever in this process. 'There was white in snow,' they say, 'in chalk, and in milk; and the sign for this common quality was the sound white.' So no doubt it is with us; but in the evolution of the human mind *the forming of concepts* represents quite a new epoch, and, like everything else in that evolution, we must try to discover some natural necessity for it. Now the first natural necessity for our

taking cognisance of two or more percepts as one lies in our own acts. Most of our acts are repeated acts. We do not strike or push or rub once only, but repeatedly. This consciousness, therefore, of our own repeated acts as one action grew by necessity into our first conceptual knowledge, and that primitive conceptual knowledge is embodied in those very roots which, as we saw, were the feeders of all human speech" (*Three Lectures on the Science of Language*, p. 28).

Now as the roots which form the fundamental elements of language express acts, that is to say, exertional acts, it would seem inevitably to follow not merely that the thought of which language is the expression is descriptive or representative of our exertional activity, but that it is itself essentially an activity. Acts can only represent acts. Acts can only be represented by acts. You cannot represent an act by a sensation, or a sensation by an act. At any rate such representation would be arbitrary, not resemblant — artificial, not natural. Accordingly, intellective acts could not be naturally and directly representative of sensations, phantasms, pictures. Such representation would be conventional and ineffective. Fundamentally and essentially, what such acts represent must be something sufficiently homogeneous to be capable of the parallelism which natural representation involves—must, in short, be acts also; and the particular analysis of the words expressive of our mental acts remarkably confirms this rule, because we have found that even when it is engaged in

expressing its own pure mental activity, language employs terms originally expressive of various forms of exertional activity.

But further, as we have seen, Professor Max Müller explains that the thoughts which represent such acts are what we commonly call concepts. Discourse, language properly so called, does not include every form of interjection, every cry of pain, every reflex response to sensation. The mental process of activity which we know as rational discourse is in essence conceptual, and it is the essential constituent of language. Concepts are what Plato intended by Ideas, and the universality or generality which characterises our ideal, conceptual, or noematical activity is ascribed, as we have seen, by Professor Max Müller to what we may term *the periodicity of our acts*,[1] to the fact that these are constantly repeated, and that the instrument which expresses their common form, irrespective of the particular instances of their occurrence, derives from this circumstance its character of universality or generality.

[1] Professor Max Müller speaks of our *acts being mostly repeated acts*. He did not appear to have grasped the idea that this repetition is really attributable to the great organic law of the periodicity of vital function: breathing, circulation of the blood, eating, sleeping, walking—all are rhythmic and periodic. This law, as we have seen, is the necessary result of the periodicity of the movements of the earth—a consequence of the action of Gravity. Thus in terms of periodicity we explain the cardinal significance and importance of the generality and ideality of Discourse. Had the suggestion of this principle occurred to Professor Müller it is easy to see that he would have valued and developed it.

The organism, in short, is not a mere capacity for transmutation, a limitless unrelated succession of unregulated functions. Experience is not an endless and never-repeated kaleidoscope.

The organism is a unity, a potent and so far permanent instrument constantly developing activity —of infinite variety in detail, no doubt,—but according to definite forms, and in accordance with definite laws, multifarious as may be the variations which the process involves. Otherwise, of course, it must be obvious that knowledge would be as impossible as it would be useless. If nothing were ever repeated there would be no general characters, or, as Plato called them, *forms* to which things could *conform*, and they would be of no value if there were. The generality of the concept is thus accounted for.

Yet, as we know from our previous studies, the ideality of thought is not in its essential nature constituted by or due to the periodicity of our acts, but to the primary fact that discourse is expressive *of action* and not of the interruptions of action in which sensation arises. All action, as we have already learned, is pure. It is in the stress of conflict between organic activity and its environment that sensation arises, the knowledge of which involves metrical estimation, reference to a standard, and the consequent loss of the ideality of pure activity.

We are furnished thus with a very simple explanation of the ideality of thought, the source of

which has so perplexed metaphysical inquirers. It is an activity representative of those forms of energy transmutation which constitute the activity of the potent organism.

Now these conclusions are obviously just the deductions which we have had reason to draw from the investigation of the other aspects of experience already submitted to our consideration.

But Max Müller says in the passage already quoted, that *nearly* all roots express acts. It behoves us, therefore, to inquire as to the exceptions at which he points. And for a clue to these we turn again to his lectures, and there we find that roots are classified and divided into two kinds—roots predicative and roots demonstrative.

Roots predicative, which form by far the larger class and are the real fundamentals of language, are the roots which express activities. What, then, are roots demonstrative? These, we find, are the roots which express the common or general features of those obstructions which our exertional activity encounters, in virtue of which sensation takes its rise, and in virtue of which knowledge is, so to speak, punctuated, becomes applied to the individual and particular, and is brought under local and temporal relations.

"Although," says Max Müller, "some of these demonstrative or pronominal or local roots—for all these names have been applied to them—may be traced back to predicative roots, we must admit a small class of independent radicals not predicative

in the usual sense of the word, but simply pointing, simply expressive of existence under certain more or less definite local or temporal prescriptions."

Such marks of local or temporal determination are really the breaks in our course or process of activity, in virtue of which our sensible experience acquires feature and definition. It is by the turn in the road that we know and featurise it; it is by the changes, the periodic changes in the flight of time, the alternations of day and night, summer and winter, that time becomes measurable and definitive. Geography and history would have no meaning if one unchanging event for ever maintained itself on a limitless undifferentiated level plain.

There is always ideality in discourse. It is itself an activity, and incapable of suffering the stresses of the environment; and even in its representation of these it, so to speak, treats them ideally or conceptually. It employs as the instrument of their expression the so-called demonstrative roots. It is by the joint instrumentality of these two classes of roots that language accomplishes the expression of our mingled exertional and sensible experience, comprising, as that experience does, both our organic motor activity and the stresses in which such motor activity is involved.

Language thus in its radical and primary form is found, when properly analysed, to exhibit itself as an instrument perfectly adapted to the representation of what we have seen to be the essential elements of our experience. And what more perfect evidence

would we desire for, what better proof could we offer of, the soundness of the analysis of experience which we have endeavoured on other grounds to submit, than just the fact that human thought and human language have unconsciously recognised and continuously express themselves in accordance with and in terms of the selfsame principles ?

The elucidation of the fundamental nature of knowledge which results from the establishment of the doctrine of an ever-transmuting energy as the explanatory key, both to experience and to cognition, enables us to set at rest with all the certainty of science many cognate questions which have perplexed inquirers for ages.

When once we understand that the meaning of a word is ultimately its dynamic significance, we not only understand the truth of the Max Müller view of the nature of Language, but we can find a place for the fragment of truth in the *bow-wow* or Onomatopœic theory which he so effectively demolished. That theory amounts simply to this—that words are representative reproductions of the sounds emitted by natural objects. Such a view is untenable, if for no other reason simply because the sounds which natural objects do emit are, as a rule, of no dynamic significance to man. It is the visual that is the natural sign and symbol of the dynamic. To a child, however, in a few familiar instances the sounds which it emits do at first and for a little time appear the most significant feature of the thing. Thus a child calls a cow a "moo."

To a man the other functions of the cow so completely overshadow its faculty of emitting this sound that it loses all significance. And he names it by reference to its true dynamic function.

In the case, however, say of the cuckoo, its faculty for emitting its familiar call remains to men, too, its chief or only significant activity, and of it, therefore, he retains the name thence derived. This explains the variety of names given in primitive languages to animals whose activities man encounters in a variety of forms. A dog is sometimes the watcher, sometimes the swift hunter, sometimes the companion, and so on.

We never classify by general terms where no common dynamic significance exists to suggest it. We have, as Max Müller points out, no common name to include all blue flowers or all red stones. We require always a common principle of activity. *Ego* is probably from the same root as ago—the actor in general. *Spiritus* and *animus* express the activity of breathing; *esse* of standing up. Man is the thinker. Breath, blood, self, express causation or action. In every case the dynamic significance of the object is the key to the meaning of its name.

Language, therefore, is originally conceptual. Keen controversy was at one time waged amongst metaphysicians as to the *primum cognitum*. Are our first cognitions particulars or universals, percepts or concepts? Are the first words names of individuals or general terms?

The explanation is easy whenever the true theory

of knowledge has been reached. It will be found, indeed, that the opposing views on this question held by Locke, Adam Smith, and others on the one hand, and by Leibniz on the other, contain both an element of truth. In the main, the true view is that of Leibniz.

Words are originally general, predicative, descriptive of activity or its results, *i.e.* of acts or facts. Professor Noiré, according to Max Müller, maintains that we never proceed to name until the act has eventuated in a fact—a result. There is an obvious reason for this. Until the effect of the act returns back upon us, reflects itself upon our experience by causing a sensation, for example, it does not stimulate attention, and cannot therefore become the object of cognition. Our first words are therefore the names of facts or qualities, but these are all the results of acts.

A child's earliest impressions are sensuous, but as the faculty of language and discourse develops, so concomitantly and concurrently develops the faculty for conceptual knowledge. Leibniz appeals with reason to the actual custom of children in this matter, and that custom incontestably confirms the view that the meanings which children ascribe to words are expressive of their dynamic significance and are not indicative of sensuous impressions. A child may be helped in identifying its mother by the sound of her voice or the colour of her clothes, but it instinctively and unconsciously yet absolutely distinguishes its mother from any such sensible

signs of her appearance. It may be misled occasionally by a change in these, but that just confirms the argument. The mistake thus made is capable of correction. If by its mother it meant a particular sound of voice or colour of clothes, then, of course, if these were changed they would not, and they could not, mislead. The different sensuous impression, audible or visual, would itself be a different thing. It is the assumption of a unity underlying the variety of sensuous impressions that renders possible their erroneous interpretation. To the child its mother is essentially a potent actor.

A child of three or four who has lived near a bridge, and heard it called by that name, will readily on the slightest suggestion of the name recognise another bridge whenever taken to it,—will recognise it as entitled to the name bridge although its visual appearance may be quite different from that of the bridge with which it has been familiar. A child who has never seen anything but a red stone railway bridge will readily recognise as a bridge a white painted wooden gangway over a stream of water, the sensible appearance of which is quite different from that of the former. It may be said that the child recognises the common purposes of the two structures, and to that statement we have no great objection. It is practically an admission of what we are contending for. What the child's understanding truly grasps is, however, better described as the dynamic significance of the bridge. The child may or may not consider the purpose for which

it was erected, but his practical reason appreciates the potent resistances which constitute the essential characteristic of the bridge.

It is thus that names acquire their meaning. A cave, as Müller points out, is something formed by cutting, scooping, hollowing out. The word is the name of the result of the actions which eventuate in the object named. Similarly the earth is that which is ploughed, and so on *ad infinitum*.

Nouns, like verbs, might be classified as active or passive, according as they express either the actor who performs the act or the result of the action. In point of fact, every name for a thing which the youngest child employs means to him in every case and always *not* a sensation or group of sensations, *but* a potent entity exemplified in actual experience by every unique instance.

The science of language leads to the conclusion that thought and language are inseparable.

There has been keen controversy on this subject, renewed in recent years by the bold arguments for their identity advanced by Max Müller. Of course we must take care not to overstate the case. Thought and audible speech are distinguishable, but though distinguishable, they are, as Max Müller explains, inseparable, at least to the extent that thought cannot proceed apart from language. They differ as do the visible and invisible steam which come from the engine funnel.[1] The energetic

[1] A good illustration of the relation of Thought and Speech appears to us to be found in the simile of the rower and his oars. Without

activity of the brain in which thought consists cannot operate except by expressing itself in the energetic activity in which language consists. That activity may or may not eventuate in sounds, but it must have done so originally; and in every case the activity which eventuates in speech is the same as that which sustains rational discourse. No doubt instinctive nervous activities proceed without the intervention of discourse. The stimuli of all motor activities which are independent of the cerebrum are necessarily of this order. Such comprise the entire activities of the articulate series, and even in the vertebrate, and in man himself, a large number of activities are thus reflex and automatic—primarily or secondarily automatic. In all such, although sensible impressions may be instrumentary to their operation, the conceptual process of discourse is entirely absent. It is to cerebral processes alone that the word mental is properly applied, and for these processes language is the necessary instrument. Except and unless by the aid of the capacity of self-expression which language affords, the process of discourse cannot be stimulated into activity, although the faculty of discourse may no doubt exist undeveloped and unexercised in the cerebrum of the absolutely deaf and dumb.

an oar the rower may execute movements similar to those which he executes when rowing, but without the oar not only are they ineffective, but the man would never acquire or develop any facility in such exercise.

"The fact that every word is originally a predicate—that names, though signs of individual conceptions, are all, without exception, derived from general ideas—is one of the most important discoveries in the Science of Language. It was known before that language is the distinguishing characteristic of man; it was known also that the having of general ideas is that which puts a perfect distinction betwixt man and brutes; but that these two were only different expressions of the same fact was not known till the theory of roots had been established as preferable to the theories both of Onomatopœa and of Interjection. But though our modern philosophy did not know it the ancient poets and framers of language must have known it. For in Greek, language is logos, but logos means also reason, and alogon was chosen as the name, and the most proper name, for the brute. No animal thinks and no animal speaks, except man. Language and thought are inseparable. Words without thought are dead sounds; thoughts without words are nothing. To think is to speak low. To speak is to think aloud. The word is the thought incarnate" (*Lectures on the Science of Language*, i. pp. 438–439).

The process of activity which we denominate discourse is originally representative of the activity of exertion.

Now what determines the appropriation of particular radical sounds to particular forms of action? On this subject, still, no doubt, largely hypothetical, Max Müller adopts as the most probable explanation the theory of the *clamor concomitans*, the view, namely, that the vocal utterances with which men naturally accompany

actions—especially concerted actions—are the true source of the fundamental radicals of speech. The elucidation of this problem will be greatly advanced when once the dynamic foundation of knowledge has been clearly apprehended and accepted as the common property of science.

A classification of roots arranged in relation to our fundamental exertional activities and the fundamental forms of the potency of Nature would supply the true scientific framework of a theory of Human Knowledge. To attempt such a classification is, however, beyond the scope of this preliminary essay.

Yet the results already achieved possess a value which has never really been appreciated, and which, indeed, could hardly be realised until the dynamic foundations of knowledge were laid bare to view.

Is it not wonderful ? Language is an instrument by which we express all the contents of cognition—all the elements and all the multifarious details of our known experience.

How was this marvellous and expressive contrivance devised and developed with an adaptability so remarkable and a completeness which never fails us ? By what system did man unconsciously construct an instrument of such infinite capacity ? The Science of Language has answered these questions. It was by a system of sounds expressive of the ordinary periodic activities of the organism. These sounds are the so-called predicative roots.

Max Müller claims to have reduced these to an ultimate minimum of about one hundred and twenty. Out of these one hundred and twenty predicative roots there has been built up the enormous fabric of human speech. Unconsciously man has adopted the one only certain sure and effective method of representing to himself in an ordered and related framework the whole contents of experience. But effective such method could only be, because based upon a true apprehension of the fact that such activities constitute the essentials of experience.

But by what means has science as its latest achievement and grandest generalisation accomplished the theoretical unification of our whole knowledge of Nature? Is it not by the doctrine which regards all physical phenomena as activities—as transmutations, according to definite laws and definite ratios, of the One Potent Energy in which Reality consists? The result has justified the method; and now is it not very interesting to find that that method is exactly one and the same as that which from the dawn of reason man has unconsciously employed in the formation and development of the great instrument of Discourse?

The regulative concepts of Science are the periodic activities of Nature. The fundamentals of cognition are supplied by the activities of the organism. The mediators are Reason and Language. And, of these, Science is no mere fortuitous and accidental offspring.

If there were no causal nexus amongst the objects of sense established in virtue of their dynamic interrelations, there could be no rational nexus predicable in Discourse and cognisable by the Mind of Man.

XXXII

MEANINGS

The Greeks, whose conceptions were much clearer than ours, limited the term ενεργεία to energy in a Kinetic form—actuality, whilst they used the term δύναμις apparently in the sense of what is now scientifically expressed as Potential Energy.

The word has in English usually been translated Force. To this rendering in itself there can be no valid objection. The term seems in many respects very suitable. But the word Force, or at least the expression "impressed force," was used by Newton in a definite sense, which is homogeneous with the meaning which it has in the expressions Force of gravity, Force of cohesion, etc. If this use of the term Force be recognised, then it is inaccurate to translate δύναμις by Force. The two concepts are distinct and different. Force in the cases above referred to is a quantitative term measuring the rate of change of momentum of a moving body. Such a rate is not and cannot be a real thing. Although its conservation was long asserted, the hopeless fallacy of such a proposition was finally demonstrated by Leibniz.

But though the rate of change of momentum is not and cannot be a real thing, it does not follow that potency is not a real thing. On the contrary, the result of the great debate between the Cartesians and the Leibnizians was to establish just this fact —that there *is* something which is conserved in all processes of physical change; that the true test of conservation is to be found in the power of doing work, *i.e.* effecting changes against Force; that it is in this that the reality of Energy or potency, so far as we are concerned, consists; and that potency, therefore, is the real postulate which the researches of dynamical science have evolved.

Moreover, although Force is not a real thing, it is shown to be the measure of the rate at which that real thing, potency, is transferred to a moving body, and thus a measure of the amount of the potency which, in virtue of its motion, such a body possesses. There is thus a definite ratio between the amount of the kinetic energy or active power which a body acquires when under the influence of a force and the force so acting upon it. It was, as we have seen, Leibniz who first established the ratio between kinetic energy and force. In whatever way this energy is communicated to the body, Leibniz proved incontestably that it is conserved, that it is, in short, a real thing, the amount of which determines the work which the body can perform. The amount of that potency can therefore always be accounted for. He determined its relation to the impressed force in the ever memorable formula MV^2. As the

mass of a body is measured by Force, that formula established a ratio between the real thing and the phenomenon. True, when we speak of a force as a rate of change of momentum we are regarding it objectively as a disturbance in the real energetic system, and not directly as a sensible phenomenon. But subjectively as a pressure it is a sensible phenomenon, just as objectively it is a measure of a rate of change. The sensation of pressure is the subjective sensible equivalent to an exertion of force when it affects the organism. The pressures and resistances which involve and constitute the fundamental features of the sensible world are measured and known in terms of Force.

Energy and Force are not, therefore, unrelated, although quite different and distinct conceptions. The speed of a railway engine and the steam in its boiler are entirely different and distinct, but very closely related. So it is with Force and Energy. Thus when we speak of a body having potential energy, we are not referring in the remotest way to any sensible feature, but to that potency which we perceive only in its results.

Leibniz anticipated the confirmation of the universal principle of Conservation so far as to recognise that the energy possessed by a moving body is not lost when its motion is stopped, but is converted into heat or some other form of equivalent value. Yet it was long afterwards—in the nineteenth century—that the mechanical equivalent of Heat was definitely ascertained. And now we

know that all the chemical and radiant energies which sustain so constant and significant a function in the sensible world are really homogeneous with the kinetic energy of motion. Thus at length the grand generalisation has been reached that, assuming the existence of energy constantly in process of transmutation, we can account quantifiably for the appearance of all the items in our whole sensible experience, and that not as disparate individuals but as related links in one interdependent system.

Such energy or potency is not, we repeat, a datum of sense at all, but a *quaesitum*, which being assumed, and assumed transmutable, offers thus a consistent explanation of the world-process. Such assumption, moreover, is no mere theoretical postulate. It is the assumption which we constantly make and must make whenever we move or act.

All scientific observation takes place on the basis of the immediate datum of experience. It was natural to assume that this inevitable datum was the real substratum underlying the whole process of Nature. Just as the chemist starts with his atoms and molecules (though we have now reason to believe that these are very complex potencies)—just as for his purposes the meteorologist starts with calm air as a datum (though we have now reason to believe that all gases are very highly energetic), so does the everyday observer with the material masses which surround him and of which he is himself a part. He not unnaturally imagines that the energetic process is superposed upon

this datum. But it has now at length become obvious that in reality we step in and begin to survey a process already in operation. These material bodies, and the atoms and molecules of which they seem, after the most extreme effort of sub-division, to be composed, are the sensible creatures and resultants of the stage at which the process has already arrived. But it is all from beginning to end *one* process of potent Kinesis.

If light and heat and sound and smell become sensible phenomena in virtue of energy transmutation, if pressure and hardness and softness do the same, what is there really left to constitute material masses? Nothing, surely, but the potency which undergoes and determines these transmutations, and in virtue of the transmutations of which these sensible phenomena arise. Not, however, until the dynamical theory of Matter was definitely formulated by physicians was there any encouraging prospect that the universal validity of potency as the one real postulate would be recognised.

Until that time the postulated pre-existence of solid extended matter remained the real stumbling-block to the acceptance of a sound theory of knowledge. For how could three-dimensioned solid bodies enter into our knowledge at all? The sensationalist, following the analogy of Vision, endeavoured to reduce them to two dimensions, and then to the smallest superficial area at that. Adopting the suggestion offered by the minute picture on the retina, he supposed that the material world

entered into cognition in the form of the small pictures of things which the retina records in the act of vision. Such an explanation was always vain and futile, and became doubly vain whenever the physiological explanation of Vision was properly understood, whenever it was shown that what actually takes place in visual sensation is an energetic change in the nervous system, that it is impossible to suggest that the visual picture on the retina is applied to or apprehended by the mind or consciousness any more than that the mind directly grasps and receives the perception of all the three-dimensioned bodies which fill our sensible world.

Hence arose the necessity for the intellectual theory of knowledge, for the suggestion that the three-dimensioned world is a fabric of the mind's construction. Had the Idealist said merely, "a fabric constructed or furnished *by the subject*," he was on a safer basis. But in referring the world-fabric to the mind he was constrained to imply that the mind constructs this fabric in accordance with the necessary laws of its own being, and thus that the unity of knowledge, the common properties of things, were ascribable merely to the similarity of structure of all cognisant minds. Such a doctrine inevitably and ineradicably contradicts every affirmation of knowledge. However things are cognised, it is not in Thought but in Activity that they are discovered. The pre-established dynamic process in which masses become phenomena is rightly recognised by common sense as the foundation both

of knowledge and of experience. The Mind's own operations are clearly distinct from and absolutely contrasted with the real data of actual experience.

Whenever we understand that in reality we are active potencies, that the visible and sensible forms of our organism and of surrounding bodies are phenomenal only, that it is in active exertion that we discover them, that the activity of thought merely reproduces and represents the activity of exertion in which these forms are revealed—then at length does it become possible to explain cognition in accordance, no doubt, with the fundamental attitude of the Kantian metaphysic, but at the same time without contradicting the ineradicable convictions of Common Sense.

The theory which postulates an ever-transmutable energy as the real thing in our Experience, the transmutations of which constitute the phenomena of sense, enables us to explain at once the transitoriness of the actual sensation and its unique relation with the real and the external. The same theory explains also the subjectivity of the spatial presentation, consistently with the objectivity of its laws and forms. This can only be done by a reference to our dynamic activity, which, unlike the activity of Thought, mingles and interacts with and upon the external environment.

This theory is the new contribution which Science offers to Metaphysics. It does not solve all speculative questions, but it does at length enable us to get rid of the perpetual contradiction which has hitherto

kept speculation oscillating between Materialism on the one hand and Idealism on the other. Such a metaphysic of existence is far from being a novelty. It was the constant object of the Indian, of the Neo-Platonist, and of many another seeker after truth in every age. But until Science, with the doctrine of Energy, laid bare the true relation between the sensible and the real it has never been able to find a foothold amidst the shifting quicksands of human belief.

XXXIII

THE UNITY OF KNOWLEDGE

In the foregoing considerations lies the meaning of the principle which we have ventured to name the dynamic foundation of knowledge.

Its proper apprehension involves not only that potency be recognised as the necessary postulate of Reason, but that it should be acknowledged to be the sole and only postulate in terms of which Reality is affirmed. Material bodies and three-dimensioned space must be relegated to their true position as the forms of the environment which our activity discovers, the forms, therefore, of the process amidst the constant operation of which organic existence arises. Much as a river is a constant process of motion of mass, so is a stone or any other material body a constant process of energy transmutation. We do not mean to suggest that a stone consists in motion of its own particles. That would be a fatuous circle. Even if there were ultimate truth in the doctrine of atoms it clearly would not help us here; still less now that the long-accepted materialist theory which held all bodies to be com-

posed of solid inert atoms is, if not untenable, certainly no longer of any *meta*physical value,—its theoretical merit being now on a par with a theory which would hold water to be composed of drops or air of particles. The stone must in the first place be considered apart from its visual symbols. We do not, in fact, refer to the visual stone but to the dynamic stone. A stone to a blind man is a resistant power, that is, an energetic process. It owes its permanence to the permanence of that process. A stream of radiant energy is as rigid and solid to the appropriate tests as is the hardest stone to our exertional test. There is a radiant materiality as real as the molecular materiality which we call body, and which is *for us* fundamental. A rainbow will survive a cannon-ball more surely than any ironclad. A current of electricity may in certain circumstances be as resistant as a rock. Transmutation of Energy is not to be confounded with motion of body. No doubt both are changes. No doubt sensible motion is dependent on and affords a measure of one transmutation process, but it is not to be confounded with that other process in which the physical world arises and by which it is constituted. We see, therefore, that not only can we explain Reality as a postulate of Reason suggested by our Activity, but that all the phenomena of sense can be co-related with Reality and explained in terms thereof as transmutations of Energy.

The most eminent natural philosophers have

always recognised and emphasised the fact that Science is not a study of sensible phenomena but of laws. Sir John Herschell has pointed this out with excellent clearness. "We must never forget," he says, "that it is principles, not phenomena, laws, not isolated independent facts, which are the objects of inquiry to the natural philosopher. We know nothing of the objects themselves which compose the universe except through the medium of the impressions they excite in us, which impressions are the result of certain actions and processes in which sensible objects and the material part of ourselves are directly concerned. Thus our observation of external nature is limited to the mutual actions of material bodies on one another."

See also Clerk Maxwell, *Matter and Motion*, art. cvii.

But until the view of Nature as a process of energetic transmutation is fully apprehended, this, the true meaning of cognition, cannot be grasped.

Knowledge and Science, it will then be seen, do not select and study certain of the more orderly and at the same time the more important of the relations subsisting between the innumerable things which constitute our Experience. On the contrary, all knowledge of Nature deals with nothing else than simply and solely energetic operations. Equally when it contemplates the most placid landscape or the most immovable of the eternal hills as when it studies the action of the hurricane or the fire, its

one single object of study and of representation is the *action of power*.

Both thought and exertion are, then, activities. Radically as we contrast and distinguish between them they are alike in this. We recognise on the one hand how the activity of exertion is bounded by the obstructions of the environment which at one and the same time impose on it its constant limitations and confer on it its unique power of relating us with the greater world of which we are a part. On the other hand, the activity of Thought, unlimited by the opponent forces of the physical system—the expression of an altogether different system of energetic transmutation—has nevertheless to confess its dependence on the physical and the sensible for the maintenance of its power as well as for its introduction to the external.

It follows, therefore, that the physiology of the organism must be the basis of our knowledge, not only of our exertional but of our mental and moral activities. Physiology studies the forms of our potent activities. The organism is the instrument, not only of motion but of emotion, not only of volition but of pure thought. Its structure as revealed to Physiology is correspondent, therefore, to the powers of which it is the expression, and is the proper scientific key to their classification and analysis.

True, mental activities, owing to the difficulty of observing in action the organic processes of the cerebrum on which they depend, are more naturally

studied *a posteriori* in their effects. The detachment of thought from the environment is the result of the isolation of the cerebrum invisible and inaccessible in the cranium. But none the less should the classification of these activities correspond to the structure of their organic instrument so far as it can be discovered and known.

We shall of course at once be told that in these statements we materialise the soul—that we confound and confuse the spiritual and the moral with the physical and the material.

But there is no foundation for such a charge. How can we materialise the soul when we affirm as the first principle of our creed the phenomenal character of Matter? On the contrary, by relegating to their proper place the sensible and the phenomenal we for ever elide the danger either of degradation or of confusion. Undoubtedly the organism in its entirety is the instrument of our whole activities, both moral and physical. Undoubtedly the universal consciousness of mankind has incessantly recognised this fact. The idea which regards the soul as a breath or spirit is originally derived from the fact that life and breath are inseparable. But when we import into this simple truth the pernicious language of hypothesis and regard the soul or real instrument of our mental life as in essence such a breath or spirit, it is *then* that we—that the advocates of such a view—really materialise the soul. Refine it, etherialise it as they may, the disciples of such a creed must still regard the soul

as something which is space-contained, and therefore in the truest sense of the term really material.

But when the organism is understood to be truly the potent source and centre of all our multifarious activities, when potency and not blind matter, however etherialised, is recognised as the true postulate of our personality, when the individual no less than his environment is understood to be a process, when space is seen to be the mere form of a process, not a continent of reality—then at length, and only then, do we avoid the degradation of materialism and the difficulties, not to say the impossibilities, of the crude spiritualism which has so often but so ineffectually been opposed to it.

The incessant process of energetic transmutation is cognised as a system consisting in the first place of permanent and enduring masses. Just as when we travel in a railway train or in a ship, those objects which are in motion along with us at the same rate appear to be at rest, whilst only those moving at a slower or a greater speed exhibit any mobility, so is it with the material world. To us it is the fundamental example of permanence and stability, and it is only in the accelerations and retardations of this constant process that we notice and can measure any perceptible change. When man "makes" a material object he does his work—the "thing" is finished, and for a time at least it appears to remain persistent and objective. He is apt in like manner to figure the World as created by its Creator and set up a finished thing. He forgets

that the analogy is misleading; that all he in fact does when he makes anything is to alter the form of a constant process, as if one should rearrange the jets of water which compose a fountain; that creation is such a constant process; that Nature is a perpetual transmutation; that, indeed, succession merely qualifies the presentation of sense. These considerations may enable us to understand not only in what the act of cognition consists, but how it accomplishes its function, how it succeeds in presenting to us a true account of reality. Thinking is a process which moves concurrently, so to say, with the process of energy transmutation in which the dynamic system partakes. It is the concomitant development of the two Activities of Thought and Action which renders knowledge possible. It is only when the cerebrum develops that the rudiments of what we call knowledge are evolved. That is what Language, that unerring philosopher, means when it gives the name consciousness to our recognition of the fact that in knowledge one form of activity is represented by another. A clear apprehension of the function of knowledge depends, therefore, on the discovery of its dynamic foundation. And not only is the dynamic system the fundamental element, the first ingredient of knowledge, but it is the sole and only means and instrument of intercommunication between different individuals—a communication without which knowledge could never develop or be of any service if it did.

It is important to avoid confusion in the use of terms. In the widest sense cerebral ideative activity is a part of Nature just as much as motor activity. But ideative activity, whilst on the one hand it is powerless, without its dynamic fulcrum, to attain to knowledge at all, on the other hand is untrammelled by the limitations which inevitably enchain the activity of exertion. It is for this reason that mankind have always in their highest and truest hours protested against any confusion between the two, and insisted in confining the words physical and natural to the world of which our exertional activity and its environing resistances are the fundamental elements.

We prefer, therefore, although here also our language is not free from objection, to employ the more limited, indeed the too limited, term dynamic as descriptive of the experience of which at any rate dynamic activity, strictly so called, is the primary and most characteristic ingredient.

The word Experience, therefore, would be properly limited to the sphere of our exertional activity. Our thoughts *per se* do not, strictly speaking, form a part of our Experience. But such Experience includes far more than sensation; it includes, nay, it essentially consists in, the exertional activity by which we participate in the world around us. We may therefore describe the two Activities of the organism as the Activities of Thought and of Experience.

Thought expressing its own pure Activity and

Thought representing Experience respectively determine, as we have already seen, two degrees of necessity and apriority, and the recognition of their respective spheres should help to a clearer definition of metaphysical terms.

By the memorable symbol of the segmented and bisected line Plato illustrates the distinction with an insight which can only be called unerring. On the intellectual side of the line two segments represent exactly the divisions of mental activity which are expressed in the gradations of apriority on which we have insisted.

XXXIV

KNOWLEDGE AND OPINION

The appreciation of the dynamic foundation of knowledge makes clearer also Plato's perpetual contrast between knowledge and opinion.

In the dialogue *Meno*, the question discussed is whether virtue is docible. To be docible, Socrates maintains it must be of the nature of knowledge. Knowledge proper—Science—can be taught as he there maintains, because its principles are somehow innate. He endeavours by a famous experiment to prove that the principles of Geometry are innate in the uninstructed mind of a youth. That no one, not even the most virtuous, could teach virtue was due to the fact that their apprehension of its principles was but a fortunate guess. Science excels such fortunate guesses or true opinions in the certainty of its foundation. The latter are like certain mobile figures of the artist Dædalus, beautiful but fleeting, the former like certain other creations of the same artist which were fixed and stable. It is the same, he tells us with all true opinions. As long as you keep hold of them they, too, are beauti-

ful and valuable possessions, but they have a way of escaping out of the mind of the possessor, and are therefore of little value until you fix them by the reasoning of Causation.

Now this reasoning of Causation, which is with Plato the basis of true Science, is but another name for that mental Activity by which, from the data of our own exertional action, we conceive and represent the process of Energetic transmutation by which our organic activity is primarily determined, and upon which, like a compass on its gimballs, the whole fabric of Cognition is poised.

If the mind could with equal certainty cognise and represent all the forms of our Activity as it does those of exertion, Science would possess the world of morals with a certainty equal to that with which it grasps the familiar facts of physical law. In such event the domain of conscience would become as extensive as that of Common Sense. The entire policy of the state, and not merely the motive impulses of the individual, could be controlled and regulated upon a scheme as certain as that by which the navigator lays off his course or the astronomer predicts the movements of the most distant planet. Then virtue would be as docible as arithmetic, and universal harmony would prevail in a world of perfect goodwill.

Though he never incorporated the principle of its dynamic foundation expressly in his scheme of knowledge, Plato gives no obscure intimation (were it only what he called an intuitive guess) of its truth. "Since

this fretted sky is still a part of the visible world, we are bound to regard it, though the most beautiful and perfect of visible things, as far inferior, nevertheless, to those true revolutions which real velocity and real slowness existing in true number and in all true forms accomplish relatively to each other, carrying with them all that they contain; which are verily apprehensible by reason and thought, but not by sight" (*Republic*, vii. 529).

What is the meaning of this passage unless it is an early anticipation of the principle which the advance of Science has now enabled us to affirm with a definite certainty? The real, Plato seems to have dimly perceived to be a potent kinesis, in the multiplicity of which the world consists and to which the whole world of sense is as the foam upon the ocean. But not until Science has enabled us to regard this process of Nature as a measurable kinesis, and to deduce therefrom in reasoned order all the phenomena of sense, has it been possible to realise the true relation between Sense and Science.

Never before has it been possible for the disciple of any school to say, as he walks amidst the ruins of the Parthenon, "The sensible is transitory and mutable, yet these are the very stones amidst which Plato walked, which he touched and looked upon." That eternal enigma, that universal paradox, can only be explained by the concept of Energy. Thus alone can our belief in the permanence and persistence of the material become true not only for common sense but for Philosophy; for the view that

such permanence is the permanence *of a process* not only harmonises with but directly involves the mutability of the things of sense.

It is the objects of reflection which are real. Why should the mental process so curiously denominated reflection be the guarantor of reality? Surely because it is in turning back from the ever-present and ever-clamant impression of Sense upon its own pure Activity that the mind becomes conscious of Reality and of the pure activities in which Reality expresses itself.

It is in sensation that consciousness is awakened. It must revert by a reflective process to the contemplation of pure activity either exertional or mental.

John Locke, in his memorable *Essay on the Human Understanding*, recognised the two activities of the organism.

In dealing with the idea of Power (bk. ii. ch. xxi. sec. 4), he points out that "all power relates to action, and that there are but two sorts of action whereof we have any idea, namely, Thinking and Motion."

No one, indeed, has had a clearer notion of the nature of Power than that straightforward thinker. But his whole philosophy of the understanding was obscured by the one defect that he regarded "body" as a real self-existent thing. He had no clue to the conception of materiality as an energetic process.

He was always confronted, therefore, although he

never clearly realised where the difficulty lay, by the insuperable difficulty of understanding how such "bodies" succeed in gaining an entrance into consciousness, of how the mind could apprehend in their magnitude the solid extended masses of the material world. The hopeless inconsistencies which disfigure his wonderful *Essay* are practically all traceable to this one source. What, indeed, might he not have done had he gained a view of the material world as a potent kinesis and conceived of Perception as an Activity representative of this process? Then might he have apprehended to the full the true meaning, the true value, and the true significance of Sense. Appreciating its position as the necessary basis of knowledge, we see in common sense the ordinary man's recognition of the common conditions of our exertional activity, the recognition of which is the necessity of sane cognition. We see at the same time that, Knowledge being really a reproduction not of sensation but of the dynamic process, it is in the apprehension of this process that understanding consists; that the truly powerful mind is that which apprehends the dynamic relations of things; that it is the weak, the frivolous, the unintelligent who are misled by the sensible appearance and who require the constant stimulus of sensation to sustain their interest. We realise that this necessarily applies not only to ordinary knowledge, not only to business and politics, but to Science in its highest efforts and to Art in every form in which it finds expression.

To the understanding heart the glare of the sensible only obscures the true reality. The vision of the true seer penetrates through the brightness of noon to the inner working of the real.

> "When the sweet breath that fills
> The heart of sunset o'er the west is rolled
> And dissipates the imperishable hills
> To haziness of gold.
>
> "When Titan Night anew
> Heaves o'er the globe her starry linked chain
> From lonely Sirius in the Southern blue
> Round to the frozen Wain.
>
> "*Then* the vivacious air
> Is filled with sprites; beneath its dusky stole
> Far spaces through the opening hemisphere
> Flush crimson with a soul.
>
> . . . .
>
> "Till from Night's dusky shores
> The waves break backward when the morn is grey
> And a new crimson o'er the plain restores
> The darkness of the day." [1]

Here is the great paradox of human life, and here the reason why all the great teachers of mankind have veiled or seemed to veil their imperishable lessons in paradox. A true understanding of the dynamic foundation of knowledge is essential to its interpretation.

It was said by Locke and others that all our abstract ideas are derived from sensible ideas; and if this be a heresy, was it not maintained by their opponents that those were the proper creatures

[1] *Longman's Magazine.*

of pure intellective activity? We quote from Locke (III. i. 5):—

"It may also lead us a little towards the original of all our notions and knowledge if we remark how great a dependence our words have on common sensible ideas; and how those which are made use of to stand for actions and notions quite removed from sense, have their rise from thence, and from obvious sensible ideas are transferred to more abstruse significations and made to stand for ideas that come not under the cognisance of our senses," and he instances, "*To imagine, to apprehend, to comprehend, to adhere, to conceive, instil, disgust, disturbance, tranquillity.*

"*Spirit*," he goes on, "in its primary signification is breath, *angel*, a messenger," and so on.

This passage has formed the subject of many commentaries both favourable and unfavourable. On the one hand, it has been taken as justifying the view that all our knowledge is derived from sense. Those, on the other hand, who maintain the inadequacy of such a philosophy have felt themselves compelled to controvert it.

But the whole matter becomes quite simple and plain whenever we understand the dynamic foundation of knowledge. The true originals of language are to be found in our dynamic activity. Locke used the ambiguous term "sensible ideas." If, as he partly perceived, we realise that the *ideas associated with* sensible experience are truly representations *not* of sensation *but* of the dynamic

process in which sensation arises, all becomes plain and easy. It was the mistaken assumption that by sensible ideas are meant sensible impressions, in short, sensations, that misled so many of Locke's followers into deriving from his statements the conclusion that all knowledge arises in sensation. A reference to the very examples which he gives makes the truth quite clear. What is it to imagine but to make images, to apprehend and to comprehend but to grasp and to grasp together, and so on and on? Spirit means breath, but breath is not a sensation. It is the substantive name for the result of an action—breathing.

Locke is right in saying that all our words are derived from common sensible ideas; but that means the ideas formed of *those activities in which sensation arises*—the activities which sustain our sensible experience—in short, the dynamic process which we have so often affirmed to be the foundation of knowledge. The terms by which we describe the proper activities of thought are metaphorical adaptations of these. Our dynamic activity is the foundation both of knowledge and of language, and its forms are by analogy and metaphor extended and applied to the proper activities of the mind.

It is therefore an altogether false inference from this fact to assert that the transitory, the phenomenal, the sensible is a constituent of knowledge properly so called—far less that it is the sole and only source of knowledge. In controverting this erroneous conclusion, Cousin was undoubtedly well

justified in his vindication of the intellectuality of knowledge. But the very examples which he adduced for this purpose only serve to confirm the soundness of the solution which we have offered. *Je*, *I*, *être*, he cited as words which could not possibly be derived from any impressions of sense. The origin of *je*, *I*, *Ego* may, as Max Müller says, be doubtful, but there seems probability in the suggestion of its affinity with *ago*. The *ego* is essentially the actor. The verb "to be," again, in all its various forms expresses the activities of breathing, growing, or abiding. The activity of the subject is the first and fundamental support of knowledge—the primary criterion of reality at least for us. Whilst, therefore, as Cousin says, these primary terms do not at all suggest a derivation from sensible impressions, they *do* owe their origin to those experiences of our external activity which are the original stimulants and furnishers of knowledge.

Do we, then, confound the physical with the spiritual? Do we ignore the immediate activity of the Mind? Do we drag within the chains of sense or, if you like, of dynamic potency the loftier and immortal claims of the ideal? By no means. The activity of Thought is indeed a cerebral function. It is a function of the organism—a part of Nature in its widest sense. To those fantastic thinkers who would find in every thinking being a Soul which sits apart from and merely looks on at the experience of his life we indeed offer no hope. But they had none at any rate. The truly wise in all

ages have not failed to recognise that our purposive, our intellective, our emotional nature as a whole is an inseparable element of the one life with which we are endowed—that the clay of earth and the limitations of mortality envelop us on every side. But if with this recognition they are enabled at the same time to realise the true nature of the ineradicable distinction between the intelligible and the sensible, between the ideal with its freedom from all dynamic limitations and the motor activity by which we are co-mingled with the so-called material world, they find that these distinctions are rendered not less but more secure when based upon a candid appreciation of the dynamic foundation of knowledge.

The grandest and most remarkable of the recent advances of Science have been accomplished in the department of those phenomena which lie beyond, behind, beneath those associated with mobile masses. The application of the idea of potency to the interpretation of the ever-present and infinitely ramified phenomena of radiant energy has not only extended our knowledge of Nature but has revolutionised our conceptions. Does it seem at first as if, with the threatened disappearance of the material theory which these discoveries foreshadow, the dynamic foundation of knowledge will be undermined, that the doctrine which we have been urging in these pages is the expiring flicker of an effete view of Nature? On the contrary, the effect of these discoveries has only been *to expose and*

exhibit this dynamic foundation to view. In letting us see that the material is but a constant process of energy transmutation, it shows us, indeed, that these phenomena of mobile masses are not, as we at one time supposed, in themselves real things. It proves that they are phenomenal. None the less does it become all the clearer that the phenomena of mobile masses in which our organic activity primarily finds expression are for us the fundamental basis of our cognition; that it is from that particular eddy in the universal stream that we survey the whole; that it is, indeed, upon the fulcrum of Cohesion and Gravity that we as cognitive beings must find our poise amidst the endless energies of the Infinite. It enables us thus to dispense with the necessity, hitherto so imperative, to regard tri-dimensional space as not only a fundamental condition of our Cognition but as in itself a form of Reality. It clears the way for the recognition of the postulate of potency, and enables us thus to co-relate the subjective convictions of our Activity with the objective basis of natural phenomena. Corresponding with the distinction so early established between primary and secondary qualities of bodies, it finds in the former a name for the regulative forms of the motor activity of mobile masses in which our exertion participates and which is for us, therefore, primary, and in the latter a name for the sensible phenomena which we owe to the radiant undulations in which sensation so largely consists. It fills up, therefore, the two

segments on the other side of Plato's divided line.

In every direction the meaning of knowledge becomes luminous whenever its essential nature is apprehended. We see, for example, the meaning and utility of what is commonly called practical knowledge, that is to say, knowledge which is constantly associated with exertion, which is engaged in directing exertion and which is equipped by doing so. Herein lies the safety and advantage of such practical knowledge, herein lies the justification for the reliance which common sense has always placed upon the knowledge of the practical man. Knowledge of the processes of external nature, however carefully cultivated, is always liable to error unless tested in this way by direct exertional action. Such participation in the actual processes of the energetic world is the real guarantee of theory. Hence the advantage of experiment in the study of Nature, hence the security of the practical man's knowledge in the ordinary affairs of life. But then experiment as such is futile unless guided by purposive thought, and the practical man is not seldom dangerous because of the very limitations which constitute his value. He is limited to the sphere of his own activity. He cannot take a wider view. The theorist securely grounded on the foundation of practical knowledge can by rational deduction extend the application of the laws of action thus so far tested, and can design bridges, ships, and machines larger than

and different from any already met with in his experience.

The same principle applies not only in the department of material construction but in the sphere of public policy, in the organisation of the state and of society, indeed in every possible department of human action.

The man of real imagination must always rely on the dynamic foundation of his knowledge. He must be able with substantial accuracy to conceive and reproduce the dynamic process. Then and in these circumstances he is building on a sure foundation, and his work will stand. But whenever, divorced from practical experience and without the faculty of imaginative understanding of the processes of Nature, he ventures upon the path of fanciful construction, he becomes at once the most useless and the most dangerous of men—the faddist.

The true distinction between Imagination and mere fancy is indeed to be found in the fact that the former is based on the dynamic foundation of knowledge. The understanding of the dynamic process of Nature lies at the root of all true skill in Science and Art. Knowledge can never reach the stage of intuitive perception unless and until it attains to this result. And if accuracy and efficiency are dependent upon it, so on the other hand do we all recognise that responsibility is similiarly conditioned.

Men who would be liars if they did not agree upon facts *within* the sphere covered by the dynamic foundation of their knowledge become merely

discordant politicians when discussing the nature of processes or the effect of enactments without the limits so determined.

Whenever encountering, as every now and then they do, this inevitable touchstone they recognise its supreme authority and frankly abandon any affirmation which contradicts it, we call them men of honesty and candour. Whenever, as in the sphere of politics and still more of religion, they too often do, men persist in their preconceived assertion even when it contradicts the dynamic foundation which gives certainty to fact, then we are in the desolating presence of the uncandid, the bigoted, and the fanatical.

With what desperate fervour men strive to maintain the ideas they have once formed and cherished all readers of history know. Indeed history is little else than a record of the efforts of men to maintain ideals which were contradicted by the real laws of Nature.

Galileo's famous persecution by the Roman Council affords perhaps the most dramatic instance in human records. Galileo has long been vindicated. But the spirit which inspired his inquisitors still reigns and prevails in thousands of human hearts and is ever ready to reassert itself.

"Yet it moves." The world will take care of itself. But none will save mankind if the love of truth and freedom should grow faint. It is hard to kick against the pricks of Natural and Moral law, but the spirit which prompts the endeavour is by no means extinct to-day.

XXXV

THE GENERAL AND THE SINGULAR

THE question of the origin of concepts or of the true relation between the general and the singular is one of the cardinal questions of Philosophy. This is pointed out by Feuerbach (quoted by Max Müller from *Vorlesungen über das Wesen der Religion*, p. 153) as follows: "The question as to the relation of the species to the individual is the most important and at the same time the most difficult question of human knowledge and philosophy. This may be clearly seen from the fact that the whole history of Philosophy turns on it, and that the controversies between Stoics and Epicureans, Platonists and Aristotelians, Sceptics and Dogmatists in ancient times, and again of Nominalists and Realists in the Middle Ages, and of Idealists, Realists, and Empiricists in modern times, always point to this problem. It is one of the most difficult questions, not only because philosophers, particularly the most modern, have by a most reckless use of words introduced infinite confusion into the matter, but also because the nature of language and the nature of

thought itself, which can in no way be separated from language, takes us captive and tricks us. For every word is general, so that many philosophers see in Language itself, as being incapable of expressing what is singular, a proof that the singular and sensuous is nothing." Such is one view of the relation of Language to Singulars. The inference from the conceptual character of Language would be better expressed in the statement that the sensible *per se* is not an object of knowledge but of feeling, but that in sensation there is involved also the dynamic transmutation in which the sensible consists, out of which it arises, and which is the natural object of cognitive apprehension.

The opposite view of the relation of concepts to singulars was of new brought into notice in modern times by the speculation of Bishop Berkeley, as expressed in his famous polemic against what he was pleased to call abstract ideas. Abstraction—ἀφαίρεσις—was explained by Berkeley as follows: "I find, indeed, that I have a faculty of imagining or representing to myself the ideas of those particular things I have perceived, and of variously compounding and dividing them. I can imagine a man with two heads or the upper part of a man joined to the body of a horse. I can consider the hand, the eye, the nose, each by itself abstracted or separated from the rest of the body. But then whatever hand or eye I imagine it must have some particular shape and colour. Likewise the idea of a man that I frame to myself must be either of a white

or a black or a tawny, a straight or a crooked, a tall or a low or a middle-sized man."

This classical passage has been accepted as the text of the sensationalist school ever since its publication. From Hume to Mill they adopt it as the unquestioned foundation of the doctrine of knowledge.

Now if the statement be limited in its application to those mental reproductions of a visual image which in the course of our thoughts we sometimes pause to frame with very notable imperfection, then, so far as it goes, it might be allowed to pass without comment, though even in this reference it is sadly inadequate and inaccurate. But taken as an explanation of the process of thought in the formation of abstract ideas it is nothing short of nonsense.

In point of fact the process of Discourse does not include any such mental images at all. It is only when that process halts or pauses that we can attempt their formation. In the immeasurable majority of cases we never frame any pictorial images of the objects of Discourse. The familiar and very distinctive features of Socrates may sometimes occur to us when we pause in the train of our thoughts, but as a rule we discourse freely of Socrates and his writings without reverting for an instant to the recollection of his snub nose and rugged countenance; whilst as regards Aristotle, and indeed almost all other persons, we must confess that we never have attempted to frame any mental

picture of their personal appearance and have no notion or conception of what it is supposed to resemble.

To be consistent, if a definite picture such as Berkeley desiderates is a necessity of thought, it must surely be a complete picture in every detail. In order to comply with the law that every idea must be singular, it is clearly not enough to say that the idea of a man must be of a tall or a low or a middle-sized man. Evidently it must be of a man of an exact and definite height, correct to the minutest fraction of a millimetre. A tall man, though a less general term than a man, is still not singular, and stands in as much need of further definition as the bare term man. And the same applies to all the other characters. Again, how on Berkeley's principle could we admit the intelligibility of the distant picture? Is not the figure of a man as seen at a distance of say one hundred yards more or less general? May it not be doubtful whether it represents John or his twin brother James? Nay, even taking the nearer view, how, if a complete detail of singulars is demanded, can we accept a side view or a profile of a man, which would represent him without a nose, or with only half a face, and so on? How, again, could we ever realise the image called up by the term House of Commons? Must we frame a mental picture of every individual member? Or, again, how are we to grasp the significance of such a term as a city, a ship, and so on *ad infinitum*? Indeed, how could we ever attain to a perfect detail

of singulars? The most perfect vision leaves out the myriad details of the microscopic world.

It seems almost incredible that this doctrine of the singularity of ideas was not only enunciated by one of the most brilliant thinkers that the world has ever seen, but has been accepted since by so many of his successors. But so it is.

Yet reflection must readily convince any one that the ideas which are the instruments of Discourse or Thought are altogether different from mental pictures of sensible phenomena. Indeed, as we have no means of proving that the mental pictures in our mind are similar to, far less identical with, those in the minds of others, it is impossible that such pictures could form the subject of rational Discourse.

It is here that the Science of Language as interpreted by Max Müller comes to our aid and informs us by a detailed examination of the roots of human speech that these express not sensible images at all but actions. And then a little reflection should make it equally plain and obvious that Thought or Discourse is itself a process of Activity, and Language, of which speech is the audible result, is simply an expression of that process.

And this makes it easy to see how it is possible for Thought to represent Reality. Thought is a process of Activity which repeats, reproduces, corresponds to another process of Activity—that, namely, of our musculo-motor-exertion.

It would be an interesting inquiry to investigate

in detail how and in what way the one process represents the other. The correspondence in the very nature of the case is relational, not resemblant. This most interesting and important field has not, unfortunately, been properly investigated. The works of Noiré, Max Müller, and others offer contributions to the problem, but much remains to be done. Yet when the main principles are grasped it becomes apparent how, without self-contradiction, we can conceive the process of Thought as expressive of the process of Nature.

At the very earliest stage we recognise the homogeneity of the power which we exercise in exertion and the powers of Nature in which our organic life is involved and by which it is surrounded; and we are enabled to do so because our activity of exertion operates within the same energetic system in which the other and opponent powers are operative. We transfer, therefore, the language descriptive of individual acts to the activities which sustain the world by which we are surrounded. This transference is what Max Müller calls *the fundamental metaphor*. His work on the *Science of Thought* may be referred to for more detailed illustrations of the operation of this principle—illustrations not rashly founded on conjecture and fancy, but elaborated from the data which his unrivalled knowledge of the radicals of human speech enabled him to supply.

But whilst subjectively and unconsciously man from the earliest times has so interpreted his ex-

perience, it is only since the announcement of the doctrine of an ever-transmuting Energy that he has had an opportunity of realising that objectively the same concept of power in action offers an explanation of the whole process of Nature. Till then, an inconsistent complex of sensible qualities was hypostatised under the name of Matter. Now it can be seen that that hypostasis refers only to the permanence of transmutation, and that power in action homogeneous with the power I can myself exert is the true sustainer of the world.

The activity of exertion is limited. Our power is soon exhausted by use and requires to be replenished. Not only its quantity but the forms of possible kinesis are circumscribed. Whenever we desire to direct exertion so as effectively to influence the outer world we must strictly follow the laws of physical action. We rule but by obeying Nature's powers. Thought, if it is to be useful and effective, must always, when directed to this object, be founded upon an accurate knowledge of these natural laws. But it is equally true that Thought itself is untrammelled by these limitations. The free activity of the cerebrum embedded in the secret chambers of the organism, and without immediate connection with the motor, the sensible, or the vegetal life, never directly comes into conflict with the resistant world. Thought is apparently limited only by one law—the so-called law of contradiction. Hence the freedom of which it is so apt to boast, and hence also the explanation

of that total absence of all the limitations of the sensible and the singular which marks the activity of Discourse.

It is the function of Discourse to represent the activity of Nature. The common radicals of speech represent the common, frequently repeated actions of ordinary experience. Natural action is universally periodic. Were it otherwise, were our whole experience an ever-changing play of new sensations regulated by no law and conforming to no plan, not only would life be an absolutely different and indeed to us inconceivable thing, but there would obviously be no object and no motive for knowledge, for discourse, or for the regulation of action, which in such case could have no plans for the future and no ideals towards which to strive.

But on the contrary, not only is the dynamic activity of Nature periodic, not only are the movements which determine day and night, waking and sleeping, living and dying, regulated by law and repeated in constant harmony, but the same is true of the undulatory and radiant activities of Nature, through which we discover the so-called qualities of bodies. And therefore it is that all adjectival terms also are abstract and general.

In other words, the names of the qualities of things are general terms, because periodic action is characteristic not only of the dynamic world in which our exertion directly participates, but of the whole universe of radiant activity in which our distantial sensations arise.

Berkeley and others have suggested that we frame abstract ideas by taking a great many singular ideas and selecting what is common to all; that we thereby frame a general or abstract notion, or at least string the multitude of singulars on a general or abstract term or word.

But we do no such thing. The opening intelligence of the child frames its ordinary concepts without ever attempting to perform such a study in selection. No doubt the most familiar acts it finds constantly repeated. And this makes useful and necessary the employment of common discursive terms to express such acts. Provided with the faculty of Speech ready waiting to be exercised, and stimulated by the like activity in those by whom he is surrounded, the child naturally gives utterance to the radical vocables which express these constant activities. He does not reflectively meditate on the fact that what his words express are the dynamic activities. He does not require to do so. The inherent activity of the organism compels him to follow the lines which the constitution of his cerebral powers is adapted to pursue. It is thus, and not by any fanciful or imagined collocation and comparison of singulars, that we develop the activities of thought.

The singular is but an incident in the obstructed activity of our experience. Apart from the conceptual, it is meaningless, formless, and without quality or content. Unless concepts were already formed, or at least unless the conceptual elements

of Thought were already in operation, singulars could not be apprehended at all under any cognisable predicate.

We are now therefore able to explain the true relation between the general and the specific.

Genus and species are terms of universal use both in science and metaphysics, and a usual understanding of their meaning, at least in zoological science, is that species includes all singulars which can be traced to a common origin, whilst genus connotes a class still more extensive. Such a view of these terms we owe not to Aristotle, who first contrasted them, but to Porphyry, who set up the "Difference" as the fifth Predicable. Aristotle himself, as Archbishop Thomson pointed out, regarded the "Difference" as another genus and the species as that more intensive class which combined the qualities of two genera—necessarily, therefore, more limited in extension and probably characterised by the feature of apparent similarity.

Max Müller points out that philologically the meanings of the two terms are quite different from those suggested by the usage above referred to. It is Genus which by its etymology implies community of origin. Species points to a classification based not on community of origin but on similarity of appearance. Their difference, therefore, is not properly a difference of extension and intension, but refers to the two great principles of classification upon one or other of which all science must be based—either upon the vital

character which determines the potent activity of the organism or upon the common similarity of external appearance. It may not be possible or needful immediately to restore to these terms their proper etymological meaning, but it is important that such meaning should be kept in mind, so that in due time they may perform their proper offices in the scientific language of the future.

The relation, then, of the singular to the general is not simply that of the individual to the class or of one to many. The general is not selected by collection or collocation of singulars. The generality of Predicables does not depend on the multiplicity of instances. When the nature of Discourse and the process of Nature are properly understood, it will be found that the general—the conceptual—expresses the kinetic activity of the world-process, whilst the singular denotes the breaks, the interruptions, the turnings by which that process is punctuated and defined in space and time.

The relation between the singular and the general, therefore, is comparable to that between the static and the dynamic, or more correctly, perhaps, the kinetic, and to this relation corresponds the fundamental classification of the parts of speech into Demonstratives and Predicables, and of the sources of knowledge into the *a posteriori* and the *a priori*. And as Max Müller well shows, the further analysis of the parts of speech which the students of Language have recognised is reflected with remarkable accuracy in the Predicaments of Aristotle—a catalogue

which, if imperfect, has hardly been improved upon by his successors—and in this way a faithful study of the fundamentals of Discourse gives us a clue not, indeed, to the laws of the dynamic process of Nature, as was erroneously supposed in medieval times, but to the forms under which the activities of Nature are necessarily apprehended by our Cognition.

The Realists held that Universals were real. In Plato's day men never imagined that Thought could be Reality. These were always contrasted. Hence if Universals were real, they must have existed not only in thought but also in the alogical. Nor was it ever supposed then that Reality was constituted by a mental affirmation. If Universals were real, that meant that they existed not only in Thought but in Nature. What was meant by being real was that the thing thought represented something which was not Thought. Of course Reality in its widest sense must include the Thinker of the Thought. But a Thought regarded as such, a Thinker's act, is a mental assertion that there exists in Nature the original of the Thought; and, of such original, Thought might be the image but could not be the author and cause.

These ancient convictions have persisted throughout the ages, and speculation has been little else than a ceaseless conflict between those who rested on the unflinching persuasion that the fundamental metaphor was well founded—however obscure such foundation might be—and those who, because

the foundation was obscure, threw doubts upon its existence. That foundation being laid bare, those convictions are vindicated and these doubts for ever laid to rest.

And this fundamental metaphor of which we have spoken is the clue also to the great problem of transcendence.

"How is it," philosophers are ever asking, "that we get beyond ourselves? How is it—if the sensible is nothing unless it is perceived—that we find in that sensible world itself something which transcends our thought—which is greater than and independent of ourselves? Nay, how is it that these fundamental forms which seem to be the most necessary conditions of our thought and knowledge seem to be at the same time the basal forms of the transcendent world?"

The truth is, however, that we never do require to get beyond ourselves. We begin so. We start life in the external. Our earliest experience arises in the stresses of the exertional system. The philosophers have confounded the transcending of our Thought or of our Sensibility with the transcending of our experience. Hence they have been perpetually perplexed by the question of the possibility of *a priori* knowledge. If the sensible, which seems to be the external, is truly subjective, they argue that knowledge of reality must be a datum prior to experience.

This question of the possibility of such *a priori* knowledge has been often simply stated in the

following terms:—"Whether is all our knowledge derived from experience, or do we possess some knowledge which is not supplied to us by the senses alone?" Such a statement of the question may fairly be accepted as a perfectly accurate expression of the form in which the problem has been discussed and debated for centuries past.

Yet does not the theory of Energy, in laying bare the dynamic foundation of our knowledge, at the same time make it evident that philosophers have all along been debating about the opposite sides of the shield? For does it not show us that both propositions may be and in fact are true —that all our knowledge *is* derived from experience and that nevertheless we *do* possess knowledge which is not supplied by the senses alone? Whenever it becomes clear that experience is an activity and that sensation only arises when that activity is obstructed, it at the same time becomes clear that in the former we find the true, necessary, natural, and obvious source of our *a priori* concepts, and at the same time that these could never derive either their necessity or their universality from sensation.

The immense mass of literature which has grown up around this simple question can now be laid on the shelf like the forgotten controversies of the early physicians. It is remarkable how near the Greeks were to solving the problem. Had there been but one thinker more to carry forward the work of Aristotle, it is, at any rate, possible that

the dynamic foundation of knowledge might have been exposed, and that the energies of mankind during the last two thousand years might have been liberated from the endless controversy which has obscured, confused, and enthralled Philosophy, and from the uncandid casuistry by which men have so often striven to find a solution. But it was not to be; and Speculation consequently has had no definite basis and no obvious goal.

Starting with the maxim that *esse est percipi*, men readily come to regard that proposition as affording the ultimate guarantee of Reality, and hence the community of Thought, the common objectivity of Experience, have been explained by the suggestion that all things are perceived if not by us by some one else. Nay, an absolute intelligence all percipient is invoked to sustain the sensible world in permanent being. But any such explanations of transcendence have always broken down, and latterly it has come to be realised that somehow we must reach a common or unitary and supra-sensible context, in which all things must find their appropriate place and acquire thus their real significance for each of us.

The insufficiency of any explanation of the reality of the world in terms of its being perceived, or even of its being known (and many writers fail to tell us which of these they mean), must have occurred from time to time to every candid thinker. For to be real does not mean to be perceived by some one else—not even by the Absolute. It has, in fact, no

reference at all to any other sentience or intelligence. It means to persist when *not* perceived. It means that which *does* persist although unperceived. Nay, it means in the last resort that which persists *as opposed to* that which is perceived. The sensible is in very truth the actual, and has a unique relation to the real, but the guarantee of reality is to be found not in the relation of things to our sensitive consciousness, but in their relation to our exertional activity, to that activity by which, and by which alone, we are mingled with and discover in operation the real world.

Sentience after all is but a very localised constituent of the Universe. To base reality on the actuality of percipient consciousness is surely vain. But intelligence is still more limited in its distribution. If the Philosophy which has claimed to account for all things by an evolution of absolute Thought has been pretentious and self-confident, it is equally certain that its collapse is destined to be complete. Our conviction of reality does not depend on the society of our fellows.

To be the solitary occupant of a desert island must doubtless prove a very maddening experience. But its disturbing influence is due to the effect which it would have upon our emotional nature. If the temperament should be sufficiently strong to resist such emotional disturbance, or can find compensation in the companionship of cat and parrot, as seems to have been the case with Robinson Crusoe, the cognitive faculties would remain unaffected, and

the reality of the world to such a one would be as clear and definite as to the busiest denizen of London, and would be unaffected even if an obliterative cataclysm should have destroyed all human or all animal life in the entire remainder of the globe.

XXXVI

THE DYNAMIC THEORY APPLIED TO ECONOMICS[1]

To recapitulate once more, we have found the reality which sustains experience to be for us in essence power ;—and not merely power, but power conceived as an energy containing within itself the principle of its own evolution ; an energy constantly transmuting itself and in its transmutations furnishing the entire presentation of sense.

We have found reason to regard the world as an endless series of such transmutation processes, and to believe that science or the knowledge of nature has been unified by the universal employment and application of this concept. We have found, further, that our organism comprises two principal activities —the muscular activity by which it mingles with its environment, and the cerebral or mental activity which is independent of the stresses of physical opposition, but which is primarily devoted to the recognition or representation of the dynamic process.

This cerebral activity is just what we call thought

[1] Reprinted with alterations from the author's essay on *The Function of Labour in the Production of Wealth.*

or reasoning—the process of discourse. Not only does it enable us to reason, to frame concepts, to know the relations of things, to affirm the reality of the potent authors of sensible change, and to understand their operation; it further renders possible to us what we know as deliberate volition. In enabling us to conceive and know, it enables us also to frame ideals, to set up ends or objects of action, and to direct and influence our musculo-motor activity in reference thereto and in accordance therewith. In Instinct, the response between stimulus and action is immediate and automatic. The cerebrum, however, sits apart as on a throne, and the stimuli which reach up to it can, so to speak, be represented, considered, and selected before action is taken.

Notwithstanding the multiplicity of acts which must always remain instinctive and automatic, the main purposes of human life are determined in accordance with ideals thus set up. Our activity as social and rational beings should in the main be guided and directed in accordance with such ideal ends. We recognise their superior claims, in competition with appetite and desire, and in such recognition morality takes its rise. A life so directed is a life of virtue, and the capacity for such direction is what the Greeks would have called σωφροσύνη.

But we are not altogether free in the choice of ends. We are not left to the pure action of deliberate volition. Life, as well as Knowledge, rests on a dynamic basis. By the very conditions of the problem we are compelled in the first place to

recognise as an end the maintenance of physical organic life, and by the constitution of our organism we are constantly reminded of this and are impelled by our natural desires to endeavour towards its attainment. What, then, are the further ends of action, or what should they be? Pleasure, power, theoretic or artistic contemplation, charity, piety—all stand claimant, and to determine amidst their claims is the last word of Wisdom. But however this competition is decided, and however blind and helpless men, wanting guidance thereanent, may be, they cannot meantime stand still. We have said that the primary activity which endeavours after the maintenance and the comfort of life is not left to the stimulus of these ideal or theoretical motives. It is stimulated in man, as in other animals, by his natural desires and appetites, which prompt him to seek food and the other necessaries and enjoyments of life; and the satisfaction of these desires is productive of pleasurable or comfortable feelings.

There is certainly a marked difference and contrast between those things which are necessary to the maintenance of life and those which *merely* minister to our pleasure. Nevertheless the maintenance of life and the satisfaction of pleasure are frequently, we may say usually, blended. What gives us the pleasure and comfort of shelter and warmth contributes also to the preservation and maintenance of animal life.

These objects have all this feature in common,

that they minister to the satisfaction of our desires. Human activity is primarily devoted to such satisfaction irrespective of any distinction between use and pleasure.

Moreover, in the division of labour which pertains in all civilised communities each particular desire is served by the activity of particular persons devoted exclusively to that particular function. Even, therefore, should an object be one purely pleasurable and altogether useless towards the preservation of life, still as regards the producer its production is the business of his life and the means of his livelihood. Practically, therefore, no distinction is made in political economy between the producer of bread and the producer of jewels.

All the objects of human acquisition are included within the meaning of the term wealth. Wealth was defined by J. S. Mill (vol. i. p. 8) as everything which serves any human purpose and which nature does not afford gratuitously. In the main, this definition has been adopted by his successors.

The limitation to objects which nature does not afford gratuitously is obviously necessary since the subject of definition is an object of human exertion or endeavour.

As regards the positive clause in the definition, it will be observed that it clearly includes both the kinds of wealth to which we have referred. It is not usual, indeed, that a particular article can be wholly classed in one division or the other. Clothes, for instance, are usually made to combine a certain

subservience to both. The distinction between the two classes is clear and universally recognised. Use and, as opposed to it, pleasure are the terms generally employed to express it. In Economics, however, as we have seen, use includes both.

"Political Economy," says Mill (vol. i. p. 538), "has nothing to do with the comparative estimation of different uses in the judgment of a philosopher or a moralist. The use of a thing in Political Economy means its capacity to satisfy a desire, to serve a purpose. Diamonds have this capacity in a high degree."

Nevertheless, there are certain marked distinctions between the two which have been frequently noted by political economists. The principal may be said to be the following:—

1. The desires for the first class—necessaries—are, generally speaking, limited; those for the second class illimitable (Smith, bk. i. ch. ii. pt. ii.).

2. The value of objects of the first class, their real price, rises in times of poverty and distress and sinks in times of opulence and prosperity, which are always times of great abundance (of necessaries), otherwise, they could not be times of opulence and prosperity. On the other hand, the value of superfluities or luxuries as it rises in times of opulence and prosperity so it sinks in times of poverty and distress.

3. The former kind of wealth is available to be employed as capital—to support a further effort of production. The utility of the latter is wholly exhausted in their consumption.

But every definition of wealth, such as that we have already quoted, is nevertheless both unsatisfactory and unscientific. Like too many of the fundamental definitions of Political Economy it establishes and relies upon a merely subjective standard. This defect has been frequently recognised in recent years.

"The radical vice," says a recent writer, "of this unscientific character of Political Economy seems to lie in the too individual and subjective aspect under which it has been treated. Wealth, having been conceived as what satisfied desires, the definitely determinable qualities possessed by some objects, of supplying physical energy and improving the physiological constitution, are left out of account. Everything is gauged by the standard of subjective notions and desires. All desires are viewed as equally legitimate, and all that satisfies our desires as equally wealth. Value being regarded as the result of a purely mental appreciation, the social value of things in the sense of their objective utility, which is often scientifically measurable, is passed over, and the ratio of exchange is exclusively considered" (*Encyclopædia Britannica*, 9th ed. Dr. I. K. Inghram).

According to the tests of a definition which we have already acknowledged, Mill's definition is really

not a scientific definition at all. And the result of such a treatment of its fundamental notions has been to make economic science the resort and the happy hunting-ground of all the unpractical faddists who naturally resent the application of a more scientific method which they would be quite unqualified to master. Nevertheless, an objective scientific standard of wealth is the great desideratum of Economics and the necessary pre-requisite to its admission within the charmed circle of the true sciences.

The idea of matter altogether fails to supply the materials for any such definition, but it is quite otherwise with the scientific concept of energy.

What we really want in the first place is to ascertain the physical basis of life. Now what is the physical basis and support of Life? It is what we now know as potential energy. Life as a physical function is a process of combustion, and combustion is a transmutation or consumption of the availability of potential energy. The primary object of our appetitive desires is to replenish the store of such potential energy, which we principally do by the consumption of food. Shelter and clothing, which enable us to conserve and economise the stores which are furnished by our food, serve the same definite end.

"We all of us," said the late Professor Balfour Stewart, "possess a certain amount of energy in our systems, a certain capacity for doing work. By an effort of his muscles the blacksmith imparts a

formidable velocity to the massive hammer which he wields. Now, what is consumed in order to produce this? We reply, the tissues of his body are consumed. If he continues working for a long time he will wear out those tissues, and nature will call for food and rest: for the former, in order to procure the materials out of which new and energetic tissues may be constructed; for the latter, in order to furnish time and leisure for repairing the waste. Ultimately, therefore, the energy of the man is derived from the food which he eats; and if he works much, that is to say, spends a great deal of energy, he will require to eat more than if he hardly works at all. Hence it is well understood that the diet of a man sentenced to imprisonment with hard labour must be more generous than that of one who is merely imprisoned; and that the allowance of food to a soldier in time of war must be greater than in time of peace. . . . In fact, food is to the animal what fuel is to the engine. . . . It is, in truth, the combustion of the food that furnishes our frames with energy; and there is no food capable of furnishing our bodies which, if well dried, is not also capable of being burned in the air."

That portion of wealth which comprises the necessaries of life, as they are called, is obviously, therefore, potential energy, and value in use is in this case exactly determined and can be quantifiably measured and calculated in terms of the amount of available potential energy which any particular portion of wealth contains.

It is curious to note that for some reason or other the second class of objects included under the term wealth—luxuries, as they are called—are

also found on examination to be forms of potential energy. In this respect the definition of Mill is defective. Kinetic energy frequently satisfies human desires. The strains of music, for example, may do so, yet no one would class musical sounds under the term wealth, although by the terms of Mill's definition they are not really excluded. The capacity to produce such musical sounds, the instruments which produce them—these, no doubt, may be wealth, but they again are potential energy; but the actual production of such sounds, whilst it affords satisfaction to a human desire, cannot be included within the conception of wealth. In this respect, therefore, the definition of wealth, which describes it as potential energy available to satisfy human desires, is not only scientific in form and objective in basis, but more exactly comprehensive of the particulars which constitute wealth. And in this connection we may note in passing a curious contrast between the two classes of wealth which the idea of potential energy makes obvious.

Potential energy varies enormously in availability or transmutability. In so far as it ministers to our necessities it is of no value except in respect of its transmutability, whereby it is enabled to support the process of combustion in which life consists. In so far as it satisfies our desire for luxuries or for mere pleasure its value seems to depend on its intransmutability. Carbon, one of the most important of natural agents constitutive of wealth, affords a very striking example of this. As a constituent of bread

or in the form of coal it exists in a state of ready transmutability and its immense value as a supporter of life is obvious. In the form of a diamond its energy is in an almost altogether intransmutable form. Its value as an instrument for the maintenance of life is nil. Its value as a luxury is very high.

The doctrine of energy not only enables us thus to lay a scientific foundation for the science of Economics; it enables us also to solve its principal problems in a quantitative and scientific fashion.

And in the first place it enables us to ascertain definitely the scientific relation between wealth and labour. The sources of wealth, say the Economists, are labour and appropriate natural agents. The appropriate natural agents are simply natural supplies of potential energy, and the labour, as Mill and indeed all Economists admit, is simply devoted to the overcoming of their inertia and gravity in the process of moving them so as to be available for the supply of human needs. Labour is *ex hypothesi* essential to the production of wealth, for the simple reason that things which do not require labour to render them available for human use do not constitute objects of human endeavour or exertion at all, and are therefore excluded from the definition of wealth. But, nevertheless, labour or work, as we now know, is a consumption of potential energy, and, therefore, of wealth.

The establishment of the numerical estimate of work in terms of potential energy was one of the

most notable scientific achievements of the nineteenth century, as it was indeed the discovery of this particular ratio which led to the final establishment and acceptance amongst physicians of the doctrine of energy which had been foreshadowed so long before by Leibniz and Newton ; and the application of this ratio to the science of economics renders the scientific treatment of its principal problems theoretically possible. The necessary data are not always, of course, ascertainable, but whenever these are given we can calculate with mathematical accuracy the exact amount of potential energy which any particular effort of work or labour consumes.

The potential energy which is constantly supplied to an average human body is continuously expended, partly in maintaining the process of combustion in which organic life as a physical function consists, partly in supporting the labour which the individual exerts. The amount, of course, varies in every individual, but, broadly speaking, it has been calculated. The food consumed by an ordinary man represents physical energy equivalent to about 4000 foot tons of work per day; but about 400 foot tons of work, being only one-tenth of the above amount, is a usual hard day's work. Only one-tenth, therefore, of our food is available to maintain productive labour, the remaining nine-tenths being required simply to support life. In both cases what takes place is a consumption of potential energy or wealth. It is, therefore, altogether a fallacy to assert, as is often done by economic

writers, that labour is the only source of wealth. Labour is a necessary condition-precedent to the acquisition of wealth; and in this fact as well as in the beneficial discipline of the character which habits of labour imply lies the undoubted reason for the dignity of labour. The habit of physical labour is the great corrective of false sentiment and affectation, the surest link by which Ideals can be bound to Truth. It is nevertheless altogether fallacious to assert that labour is a source, far less that it is the only source, of wealth. It is, on the contrary, invariably and constantly a consumption of wealth, and the amount of such consumption as well as the fact is definite and ascertainable. In respect of the physical energy stored up in his body every labourer is to that extent a capitalist, and it is thus that he is enabled to contribute to the supply of wealth, which he can only do whilst and so long as such store of physical energy is replenished and maintained.

But if labour is truly a consumption of wealth, how, it will be asked, can wealth ever be accumulated and increased? If the process is a mere continuous cycle such as we have described, how is capital collected and profit made? To these important questions also the doctrine of energy supplies an answer at once simple, lucid, and complete.

We cannot, as we have seen, create any quantity of energy. All the human labourer does is to effect the transference of energy from one place or portion of matter to another, and so render it more available

for the necessities of life. In doing this his energy is mainly employed in overcoming the forces of gravitation and to some extent cohesion, which forces form the main obstacle to the changing of the position of material bodies ; but then there are other forms of energy, such as that due to the force of chemical affinity, which are far more powerful in proportion to the mass of the body with which they are associated than the energy due either to gravitation or cohesion. For example, the explosive energy of an ounce of gunpowder, due to the chemical arrangement of its particles, is an immeasurably more powerful agent than the potential energy which it possesses in virtue of its weight, at least at any ordinary height above the ground. Or, to take another instance more fully illustrative of the truth. A very considerable item of human wealth at present consists in coal. The value of coal, what renders it wealth, is the potential energy possessed by its particles in virtue of their chemical constitution, which fits it to support combustion, and thereby develop vast quantities of the form of energy known as heat. The energy which a piece of coal possesses of this kind may be greater far than the amount consumed in overcoming its weight and moving it to the necessary distance. Marshall gives a numerical ratio. One pound of coal, he says, will raise 100 lb. 1200 ft. high. Suppose a coal mine to be fitted up in such a way that the whole work of excavating, raising, and delivering the coal could be performed by machinery without human labour, the coal

expended in driving the steam-engine which worked the machinery of this mine might be far less than the whole coal raised, and that simply because the potential energy of chemical affinity contained in the smaller portion of coal consumed was greater than the whole forces of cohesion and gravitation requiring to be overcome in moving the entire mass excavated to the necessary place. It is out of the surplus that profit is accumulated. It is in virtue of this surplus that a production of wealth takes place. The wealth consists in the surplus potential energy of the coal, rendered available for human uses by the expenditure of the labour of raising it, etc., over and above the amount of potential energy so expended. Of course the potential energy so expended is usually partly expended in sustaining human labour; but this human labour is just consumption of another kind of potential energy, not essentially different from that of coal—namely, the energy of the food consumed by the labourers—and the total potential energy expended on the labour of collecting the coal must be less than that rendered available for use, or there is no production of wealth in the operation.

It is the same with the case of agriculture. The sum of the potential energies expended in the rearing of the crops must be less than the amount of potential energy rendered available for human uses by the operations of the farmer and his assistants, if there is to be any production of wealth from

the labour so expended. In the case of the coal, the labour is expended in transferring a body in which the potential energy already resides to a position where its energy may be made available for human uses; in the case of agriculture, the labour consists, at least at first, in so arranging certain bodies or particles of matter as to effect a transmutation of certain kinetic energy—the energy resident in the sun's rays—into the potential energy which by the agency of these rays is stored up in the plant in the form of potential energy of chemical separation. And it is in one or other of these two ways that almost all labour is exerted in the production of wealth in its primary form.

Furthermore, from this explanation we are enabled to understand not only how wealth is produced and profit made, but also how, very often, labour may be partly or entirely wasted, and loss take the place of profit. That this is so is a fact so universal and common that it is of course recognised by Mill, as when he states that "even productive labour may be wasted where more is expended than really conduces to production;" and he goes on to illustrate this truth by several very simple examples. All labour being, as we have seen, consumption of potential energy, it can only result in a production of wealth if, in some of the ways above indicated, in exchange for the potential energy consumed by the labourer another and larger quantity is made available to human uses. If, for example, in the case of a coal mine, above

quoted, it were found that the coal was of such inferior chemical constitution that its particles did not possess much potential energy; or if the extraordinary depth of the coal and the hardness of strata which had to be penetrated before it was reached involved the expenditure of a greater amount of potential energy than was present in the coal itself; or if a failure of the sun's heat, or a flood, or bad soil, so impeded the growth of the farmer's corn that the amount of potential energy which it all contained when reaped was less than that consumed by the farmer and his assistants in the agricultural process—then and in all of these cases there would be no production of wealth at all as the result of the operation. The amount of potential energy consumed by the labour being greater than that recovered and rendered available, there would, on the whole, be a consumption of potential energy, and a waste of labour and a loss of wealth.

All this is, of course, illustrated with the utmost frequency in our everyday experience. The various objects which constitute wealth have in the mercantile world their value set down in money, and these values are roughly equivalent to the amount of potential energy which they possess. Thus it is that a balance sheet and a profit and loss account are the rough and ready methods of commerce to determine whether a production of wealth has in any particular case taken place, *i.e.* whether a larger amount of potential energy has been supplied

than that consumed in the labour of supplying it.

We must therefore hold it proved—as a companion and equally important truth to the doctrine that labour is a necessary pre-requisite to the production of wealth—that the mere expenditure of labour is actually a consumption, and in no sense necessarily a production or accumulation of wealth.

A man may spend hundreds of pounds, say, in the draining of marsh land, an operation subsidiary to rendering available for human uses the energy of the sun's rays shining upon the land in question, by facilitating its conversion into the potential energy resident in such crops as man can eat, instead of the equal quantity of potential energy employed in sustaining the life of rushes and marsh weeds. But a single miscalculation of six inches in the taking of his levels may make the whole of his great drainage scheme abortive. There is here probably the very same amount of labour expended, and in almost exactly the same way, as if his levels had been right; but instead of being productive it is utterly wasted. It is all pure consumption of wealth, and does not add one single atom to the production of the world. What more conclusive evidence could there be that in the essential nature of labour itself there is really no such productive power or tendency to fructify into wealth as seems generally supposed to reside in it? To hear the ordinary orator or newspaper writer on these subjects (*e.g.* Henry George, *Social*

Problems, p. 80: "Nature gives wealth to labour and to nothing but labour"), one would think that labour, by the very virtue of its inherent nature, seemed to beget or generate wealth as a necessary consequence of its exertion. Nothing could be a greater delusion; nothing, it can be scientifically and mathematically demonstrated, could possibly be further from the truth.

But the last illustration is serviceable as showing us very clearly what it is that distinguishes the productive from the unproductive employment of labour, and enables us to select and devote our energies to the former. That, we shall soon see, is the special function of the other branch of our organic activity—that is to say, of intelligence, of thought or calculation, of that mental action which we formerly saw grouped with and included by the political economist under the general name labour.

Even Adam Smith sometimes recognises this function of thought pretty clearly, *e.g.* where he says—

> "The most important operations of agriculture seem intended not so much to increase, though they do that too, as to direct the fertility [*i.e.* the energy] of nature towards the production of the plants most profitable to man. A field overgrown with briers and brambles may frequently produce as great a quantity of vegetables as the best cultivated vineyard or cornfield, etc."

Mill also recognised so far, though imperfectly, that the function of thought is different from that of

physical labour. "Labour in the physical world," he says in a passage we have already referred to, "is always and solely employed in putting objects in motion; the properties of matter, the laws of nature, do the rest;" and he goes on to say: "The skill and ingenuity of human beings are chiefly exercised in discovering movements practicable by their powers, and capable of bringing about the effects they desire." He thus clearly recognises a difference between the functions of labour and of thought in the process of production. But the distinction is of little value to him, for he is constantly mixing up physical labour and mental action. He was not, indeed, in possession of the scientific definitions and data whereby labour proper can now, as we have seen, be distinguished and definitely measured by reference to the amount of force it overcomes.

The consumption of potential energy involved in the operations of thought is relatively inappreciable, whilst the consumption of energy involved in the maintenance of the animal life of the individual organism is not greater in the case of the thinker than in the case of the labourer. On the other hand, that thought and ingenuity are employed in comparing and observing natural objects and calculating and ascertaining in what cases the labour exerted in putting such objects in motion shall so result that an amount of potential energy shall be rendered available for use greater than the amount consumed in such exertions. In the savage state

of man, and in the lower animals, the appetites and desires naturally direct the animal energies to such movements as shall so far subserve these objects. An animal's sense of taste and smell guide it so far as to what food it should seek to sustain life. But the progress of man, the advance of civilisation, are only possible when by the exercise of thought and reason and calculation and memory man devises such means as shall render more supplies of potential energy available to sustain life. In this way, and by being able to store up such supplies, it ceases to be necessary for him to devote his whole time to the procuring of the bare necessaries of existence, and leisure for the further development of his mind becomes a possibility. This is the true meaning of the maxim that knowledge is power. Thus it is that man has gradually acquired his ever-increasing dominion over the material world.

The most elementary acts whereby life is sustained—the gathering and cooking of food, the preparation of shelter and clothing—require, of course, intelligence. It is, indeed, this which enables man to select the "appropriate" natural agents suitable for his purposes. But the influence of intelligence upon the productiveness of labour becomes more and more marked as agriculture and industry advance. Man is constantly discovering how to make plants and animals more capable of replenishing his supplies of potential energy. Take the example of manuring. It is by thought, calculation

and observation that man comes to see that by depositing certain materials in one place instead of in another, perhaps at no increased expenditure of labour, the potential energy derived from certain crops is largely augmented.

One most common way in which thought and ingenuity thus aid in the production of wealth is by taking advantage of places where a suitable transmutation is constantly going on in nature, *e.g.* by placing a water-wheel under a waterfall whereby the constant supply of energy in the falling water are rendered available for human uses. Another common method already referred to is to take advantage of the greater potential energy of chemical affinity as compared to gravity. The whole physical universe is simply a full storehouse of energy, continuously transmuting itself from one form to another. The skill and ingenuity of man intercept the multifarious stream at various points, and direct the energy into channels wherein the transmutations become serviceable to human uses and wherein portions of it can be stored up in convenient and available forms for the maintenance of animal life.

It is Thought, again, which determines before any operation is undertaken whether the result will be a profit or loss. Before the prudent coalmaster sinks his mine he determines whether the quality, *i.e.* the potential energy, of the coal is sufficiently great and whether the labour necessary to be expended in raising it is sufficiently small to secure

that the potential energy made available by the operation shall be greater than that expended. And it is the same with every other productive effort. Either (1) the thinker devises from his knowledge of nature some new arrangement of material bodies to be effected by human labour which shall render a larger amount of potential energy available than hitherto—*e.g.*, when the chemist invents some new explosive possessing more potential energy than that previously in use, or some other new material agent possessing greater potential energy of chemical separation than those previously used for the purpose; or (2) the thinker devises what is called a labour-saving arrangement—*i.e.*, some new arrangement with reference to the objects to be moved by human labour in rendering some particular amount of potential energy available to man, whereby the amount expended in the act of labour is made less, and the surplus available as an addition to human wealth is correspondingly augmented—*e.g.*, by inventing a reaping-machine to take the place of sickles; or, say, a new build of ship, which can be propelled through the water at a given speed with less expenditure of energy than before.[1]

All, counting every numerical operation, is an act of thought; every plan, design, pattern, everything which can be represented by a drawing, is another. Eliminate only these two forms of thought entirely from industrial operations, and you are in-

[1] Watt's improvements on the steam-engine are good instances.

stantly reduced to the condition of savage life. The humblest dressmaker in cutting cloth, and the great engineer of a Brooklyn Bridge, must alike have a design if the labour which they exert or direct is not to be a mere consumption of wealth and a dead loss.

The function, then, of thought in the process of production is entirely different and distinct from the function of labour. Both are necessary prerequisites to the accumulation of wealth. Neither, therefore, should quarrel with or despise the other. Both must act harmoniously together to bring about the desired result. At the same time, it should never be forgotten or overlooked that the more thought and the less labour employed in rendering available any particular quantity of potential energy, the greater will be the amount of wealth produced. The labour is, in truth, a necessary deduction from the already accumulated stores of potential energy; and the less that deduction is, the greater will be the amount of wealth when the operation is completed.

It is, of course, obvious that where the greater amount of labour is expended there is probably taking place the greater production of wealth. Supposing in two countries the methods of industry are the same, but that in the one there is double the amount of labour employed, there should be double the production of wealth. That is simply equivalent to saying that if some industrial operation which does result in a production of wealth be

repeated twice, there will be a production of double the amount of wealth ; it none the less follows that in each case the labour employed represents a consumption of wealth.

It is equally obvious, and has been clearly pointed out by Mill and most others, that the potential energy or wealth consumed by labour in any operation must have been previously accumulated at some earlier time. You cannot by anticipation support the labour out of the potential energy which is to be made available as a result of its exertion, and it is only in virtue of the potential energy already available for man's requirements without any long sustained labour that the processes of industry could ever have been started to work. The original occupations of man were those of the hunter and the fisher ; and it was by these, and by the natural spontaneous fruits yielded without labour by the earth, that he must have sustained life till his first crops were reaped and his first accumulations made. None the less is it true that the stock of wealth can only be increased if the deduction from the previously existing store involved in the expenditure of any quantity of labour is more than counterbalanced by the magnitude of the new supply which that labour has put in its place.

We proceed to point out that the doctrine of energy affords a method of quantifying the indefinite factor in a whole class of problems which the economist is interested in solving.

It enables us to quantify the value of labour by an impersonal and scientific standard entirely independent of wages, and free of all the confusions which Mill and others have so often pointed out as involved in the estimation of the value of labour by reference to the wage paid. The actual amount of labour is now constantly estimated by the amount of force overcome—foot pounds being the practical unit employed in the calculation, or, more accurately, the foot poundal or erg as a definite unit of work; and these, though primarily applicable to pure mechanical labour, can by inference and comparison be applied to animal labour as well. All this labour bears a direct relation to the amount of energy consumed in its exertion.

But our theory enables us also to calculate the amount of the other element in production, and that the most fluctuating and uncertain, namely, the inherent potential energy of the natural product made available for human uses by the labour expended upon it. To employ the language of Mill, we are supplied with a standard to measure "the degree of productiveness of natural agents."

As we have seen already, if x=the amount of potential energy existing in, say, a piece of coal, and if y represent the amount of energy necessarily consumed by the labourers who make it available for human uses, $x-y$ represents the amount of wealth recovered or, so to say, produced by the process. It has always been pretty easy to estimate nearly enough the value of the different amounts

of labour required to be expended on such processes, *i.e.* the y of the above formula; but it has not hitherto seemed possible to attain any standard beyond the exchange value whereby to estimate the amount of the x, and hence it has not seemed possible to arrive at any such standard estimation of the value of the result $x-y$. Most important of all: formerly, whilst the x and the y were not merely regarded as different quantities, but as different entities, the one could not be subtracted from the other except by medium of their money values; now, by showing that wealth and labour can both be stated in terms of energy, science has applied a means of stating x in terms of y, and eliminating one or other of the two unknown quantities from the equation.

To determinate this equation has been the dream of economists, and to Mill, and others of his school, it seemed little better than a dream. The suggestion of Adam Smith that labour, or possible corn, might come to perform such a function, indicated a true though imperfect conception of the sort of standard required; but only when the definite scientific conception of potential energy has been developed, its exact measurement by reference to constant natural forces, such as gravitation, etc., been achieved, and the great doctrine of the transmutability of its various forms into one another, and into work, been fully demonstrated and established, has the attainment of such an absolute standard of value become a practical possibility.

Of course it is one thing to make such calculations in the region of pure science, and another to apply them quantitatively to the unpurified problems of a practical science like political economy. But the principle can at least be applied qualitatively, so to speak, if not quantitatively, and even this is a gain, and will greatly simplify many economic problems and eliminate many stubborn errors. Not only the theory of values absolute as a basis and foundation of exchange values, but the whole doctrine of cost of production, so laboriously enunciated by Mill, becomes capable of enhanced clearness and abbreviation.

It is substantially the same point which crops up in the endeavour to estimate the amount of the capital accumulated by the productive process. According to Mill (bk. ii. ch. xv. sec. 6), the two elements on which, and on which alone, the gains of the capitalist depend are, first, "the magnitude of the produce," depending on "the productive power of labour"; and, secondly, the proportion of that produce obtained by the labourers themselves. It is not difficult for us now to see how inadequate a synonym the productive power of labour is for the magnitude of the produce. That produce is the x of the equation we referred to, and it depends upon the amount of the potential energy resident in the natural object made available by the labour (the y); and the same scientific theory which shows that energy, in whatever form it be, is homogeneous with, and transmutable into,

the energy which supports labour, makes it also clear that the amount of the said x bears no necessary relation to the amount of the labour expended in producing it. The x must be greater than the y if there is to be any gain at all; but knowledge of nature and of natural laws and bodies, skill in calculating how best to acquire possession of them, and very often good luck, in the shape, say, of a happy discovery, such as the finding of a rich mine or such-like—these are the things which determine the magnitude of the produce and not the ratio it bears to the amount of labour consumed.

Thus, if insurance, interest, and wages of superintendence be the three elements of all profit, the two first being the comparatively stationary and calculable elements, the last is clearly seen now to be far more than a mere wage of superintendence. It is the result and reward of the skill and thought which determine whether the productive effort shall be a profit at all, or of the luck which stumbles on an exceptionally large store of natural potential energy.

XXXVII

THE DYNAMIC THEORY APPLIED TO EDUCATION

THE theory of knowledge which we have advanced in the foregoing pages supplies us with one or two useful principles for the establishment of a sound theory of Education.

So much is said and done about Education that it almost seems necessary to point out that Education is not anything and everything. The word has a definite meaning, and the true principles which should determine its forms are embedded in its name.

Education is a drawing out. Now of what is it a drawing out? Obviously it is a drawing out and development of the noematical activity of the cerebrum—the activity of Reason and Imagination—of what we have called the power or faculty of Ideation or Discourse, with the resultant recognition of the Ideal which is most appropriately named Conscience. These activities, if not strengthened and developed, are ever apt to be smothered and overwhelmed by the greater vigour of the instincts, the appetites, and the senses.

So to strengthen and develop the activity of

Discourse—in short, to teach us to think—is the great aim and object of Education, and it is one which must be accomplished in youth before these lower motives acquire full and uncontrolled dominion.

Education, then, is properly a process whereby the Reason and Conscience are developed and strengthened so as gradually to attain their true position as the dominant impulses of our nature, controlling the appetites and passions which, without guidance, have a tendency to become all-powerful and to control the whole actions of the man.

How, then, is this drawing out of the Reason and Conscience to be effected? The answer is: In the same way as in the case of any other faculty, namely, by frequent and judicious exercise. Just as any particular muscle is developed and strengthened—is drawn out from its obscurity by regular and judicious exercise—so it is with the Reason. Now, if we wish to exercise the muscles of, say, the arm, how do we proceed? We supply the individual with an appropriate instrument, by the constant use of which the muscle is exercised and developed. In the same way if we wish to exercise and develop the musical faculty, or the power, say, of writing, we supply the individual with a piano or a pen, by the use of which the desired result is attained.

It is the same with Reason. Now the instrument of the Reason is Language. The first step in Education, therefore, is to draw out the faculty of

Language by training the power of speech. That being done, there comes next the further development of the Reason by the exercise of the faculty of writing. It is here that the special training of a school comes in, and thus it is that the exercise of Reading and Writing are the fundamental elements in all Education. The greater efficiency of written signs owing to the greater power of vision as compared with hearing is obvious. But the artificiality of writing as contrasted with speech renders the special machinery of school necessary for its acquirement. It is only by the aid of writing that the experiences of the past can be preserved for the benefit of the future, and that in this way the intellectual progress of the race becomes a possibility. Education is hardly possible until this is accomplished, and Education, therefore, undoubtedly consists fundamentally in the teaching of Reading, Writing, and Grammar.

But Human Reason, according to the subject with which it deals, employs one or other of two methods—the qualitative and the quantitative, or the logical and the mathematical. In expressing its own activity, its own processes and operations, the former is appropriate, but in dealing with the processes of the external world—with the dynamic activities of nature, the mathematical method—in a word quantification, is alone effective.

The application of mathematical methods is the distinguishing feature of modern Thought, and to it we owe the efficiency of physical science. The

Greeks and the mediaevals were as successful as we are in the use of the logical method. But they employed it erroneously and to the exclusion of the mathematical method in their reasoning about Nature—a fact which largely explains their small progress in physical knowledge.

When the Reason is exercised upon matters to which this method is properly applicable the mental process assumes the special forms which we describe as metrical and enumerative, and a special set of signs are invented and employed to denote and aid the operations of Discourse in such cases. These signs are figures, and hence it is that arithmetic forms the next branch of Education.

The common sense of mankind has rightly decided that Reading, Writing, and Arithmetic should form the basis of all Education.

But the matter becomes more difficult when we approach the question of what subjects are entitled to follow.

The development of the study of Language in grammar and composition appears clearly entitled to the next place, and training in composition is best effected by the study of another form of linguistic expression—that is to say, a foreign language. Of all such, Greek is unquestionably the most copious and perfect. At least for the student of the Science of Nature Greek is the most suitable instrumentary help. For the student of Human Activity, of law, and politics, Latin offers almost equal advantages.

Next would come History as a record of the social activities of men as rational and moral beings, and Logic as the theory of the reasoning process.

In the other direction we approach the study of the external world, of the dynamic system of Nature. This must be regarded from two standpoints: (1) the exertional activity of the organism; (2) the dynamic activity of the environment. The study of the former is the subject-matter of Geometry, of the latter of the natural sciences. The knowledge of Nature should start with and be founded on knowledge of the position and agency of the Sun. The object of true scientific knowledge is to cognise and understand the dynamic system as a whole. The cardinal lesson which in this respect we have all to learn is to realise that the small bright radiant object we call the Sun is the true centre and supporter of our animate existence[1]—the source from which proceeds the light and heat without which Life would be an impossibility, and which determines and controls the main periodic movements of our physical environment. And the most general information we *can* give a child is to tell him the elementary facts about our dynamic relations with the Sun. That lesson is also the most splendid example of Reason correcting sensation. Geography or Physiography, therefore, astronomical and physical, seem the fundamental subject of Education in the knowledge of Nature.

[1] Plato's *Republic*, bk. ii.

To this study may be added elementary lessons in one branch of observational science. Further than this the teaching of science should not be attempted in general education. The study of any one branch of Science accurately and systematically is professional, and not to be attempted as a mere item in general training. However desirable such knowledge, if complete and adequate, must be, it is valueless unless acquired in a complete and practical form. The time spent in merely superficial and unpractical repetition of phrases and terms soon forgotten and never really understood is worse than wasted. Education to be effective must be limited to the development of our cognitive activity and involves an honest recognition of its limitations.

Further, whilst Education should be adapted to *fit* us for the work of life—as such an education as we have already sketched would do—by developing the noematical activity of the cerebrum, it is altogether outside its sphere to endeavour to teach the particular arts or crafts by which the great majority are obliged to seek a means of living. Such teaching is indispensably necessary, and its efficiency a national object of the first importance. But it is not education. It is altogether outside the scope of education. All attempts to teach particular trades and crafts at school have always resulted and will always result in failure. By withdrawing time which should be devoted to education proper, as above defined, educators

deprive the child of a real education and they offer no satisfactory substitute.

Lastly, all Education must aim at training, cultivating, and developing the activity of the youthful mind by teaching it to represent truly, to think again the real process of Nature. Leading it past the mere contemplation of the appearance which is the object of all false Education, the Mind must be guided to *understand* the potent operations in the apprehension of which true knowledge consists.

XXXVIII

THE DYNAMIC FOUNDATION OF METRICAL STANDARDS

IF we recognise, in our exertional activity, the foundation and basis of knowledge, we must recognise also that our organic experience is primarily determined by the dynamic laws of the physical process. Fundamentally these are characterised by the feature of tridimensionality.

The organisation of life, the systematisation of knowledge, the practical application of the latter to the former, which is accomplished in the Arts of Life, demand and require the use of metrical standards. The perfection of such standards—which would include the standardisation of sizes and quantities of all things in use—would be the perfection of the economic instruments of Civilisation. It would enormously simplify and facilitate the work of man and liberate his time and energy for ideal pursuits.

Tridimensionality requires that all quantification should be based on a duodecimal system both of notation and of metrical ratios.

The accident or the fact that there are five

fingers on the human hand has determined man to the employment of a decimal system. In reality it is more correct to say that there are four fingers and a thumb. But beyond the use of the fingers in enumeration by infants and savages—and seldom even by them — their number has no practical relation to the requirements of enumeration or measurement.

We do not naturally divide things into fives. We divide most naturally by two and in the next degree by three. A more intricate ratio is not only not required but is unsuitable to use. Equality of division becomes practically unattainable. We halve things and again we quarter them, or we double them, treble them, or quadruple them. But we seldom divide them into fives or multiply them by five.

The earth is a globe in tridimensional space, the heavens an apparent sphere. Their figures are adapted to a quarterly division only. There are four cardinal directions. The universal principle of their subdivision is by ratios of two and four. A decimal division of the compass is impracticable.

As a result of tridimensionality, the division not only of the compass but of the sphere should be quarterly, not decimal. The reformers of the French Revolution when they introduced their decimal system of weights and measures propounded also a decimal division of the circle—a substitution of 400 degrees for 360. Of this it has been remarked: "The decimal division of the right angle decreed

by the French Republic when it successfully introduced other more sweeping changes utterly and deservedly failed" (Kelvin and Tait, *Elements of Natural Philosophy*, p. 124).

The inconvenience of such a decimal division arises not merely from the unsuitability of five as a divisor, but from the disparity which it would have introduced between circular measure and its conversion into measures of time. The earth's rotation being our unit measure of time, and daily time being universally divided into hours, minutes, and seconds on a duodecimal basis, a correspondence between circular measure and measures of time can only be stated satisfactorily by the instrumentality of a duodecimal division of the circle.

When linear measure requires to be converted into superficial or cubical—and this is a prime necessity of every act of life—tridimensionality again controls and limits us. The square and the cube are the natural creatures of tridimensionality, and we cannot get away from them.

Areas are measured in the square, capacity by the cube. We cannot avoid it.

These considerations are reinforced by the law of gravity which so far determines the natural form of our artificial structures. It requires us to make our walls vertical, *i.e.* at an angle of 90° to the earth. If we try to build them at 72° they will not stand up. Our houses and our rooms are rectangular in principle, never pentagonal. We can imagine the troubles which would ensue were

we to build in the latter principle. Utility would be seriously interfered with, and even stability would be endangered. It would be impracticable. The shape of our rooms is followed by that of our furniture. Our beds, our tables are rectangular. Our bookcases, our books, papers, pictures, our carriages, carts, vehicles—all are rectangular in their main principles, never pentagonal. The human body has a front and back and two sides. Our hands, feet, ears are in pairs.

You cannot get rid of the multiple of 2 and 4, nor of the incessant use of rectangular form.

This applies not merely to vehicles and carriages of all kinds, but to the boxes, cases, etc., which they carry. Imagine the packing of pentagonal boxes in rectangular vehicles. If the cases are rectangular their contents cannot be packed in tens. They usually can only be filled in twelves. Hence the almost universal employment of the dozen as a purchase unit. Try to put ten articles into a rectangular basket. They are not so easily counted or arranged as twelve.

In view of these facts it is evident that the adoption of a decimal system of numerical notation has been one of the greatest practical calamities which have ever affected civilisation. Had we had a duodecimal notation our weights and measures could all have been naturally arranged in conformity therewith on a duodecimal scale, which in that case would have had all the simplicity of decimal system for calculation, together with all the

natural advantages of a duodecimal multiple. So universal, however, has the use of a decimal notation become, and so long has it prevailed, that it is probably hopeless, even if it were desirable, to look now for the substitution of a duodecimal system. One of the greatest difficulties would be the disturbance of chronology. The centuries would cry out. This objection might be alleviated by enforcing the universal use for the purpose of recording dates of the Roman notation, now occasionally employed for that purpose. But without the unanimous concurrence of the scientific world—of which there is no prospect—such a change is outside the scope of practical politics. Certainly, in any case, the disturbance which its introduction would involve would be enormous.

In the meantime, then, the decimal notation being in general use, there is an obvious advantage in having metrical ratios which correspond to the ratios of enumeration. This was the excuse for the adoption of the decimal system of Weights and Measures by the French revolutionaries.

In certain of the exact Sciences, such as chemistry, which are unaffected by tridimensionality the resulting advantage is unmixed with any drawback.

In most of the Sciences, in the practical application of dynamics to engineering, in all trade and commerce, there are serious disadvantages in the decimal notation. The decimal metric system obviates many of these, but it has the drawback of disregarding all the practical units of the system pre-

viously and still largely in use. The fantastic and unnatural origin of the unit-fundamental adopted by the decimalists, namely, the 10,000,000th part of a quadrant of the meridian, has the further objection that it was incorrectly taken.

On the other hand, the advantages of the decimal metric system are emphasised by the irregularities and inconsistencies of all the other metric systems of any importance.

The duodecimal or sexagesimal ratios employed in our measures of time and in our civil calendar being simple and international must be preserved, the latter being simplified by removal of irregularities — a reform easily attainable without disturbance. For Weights and Measures a simple duodecimal scheme might be agreed upon and legalised —concurrently with the decimal system—for use where found preferable in trade and commerce. Of such the following appears to the writer, after careful consideration, to be the simplest and best.

LENGTH

10 yds.	=	1 pole				
120 „	=	12 poles	=	1 furlong		
1440 „	=	144 „	=	12 „	=	1 mile

WEIGHT

10 lb.	=	1 stone				
120 „	=	12 „	=	1 quarter		
1440 „	=	144 „	=	12 „	=	1 ton

NOTE.—(*a*) 10 lb. = the weight of 1 gal. of distilled water.
(*b*) 60 „ = 1 standard bushel of wheat, potato, or clover seed.

It is probably, however, too late now to attempt even this concession to duodecimal demands.

But there is one very simple change which might surely still be effected, and that is an adjustment of the standard length of the metre so as to secure a commensurable ratio between the decimal and the Anglo-Saxon units. Sir Sandford Fleming, to whom the world owes the suggestion of our system of standard time, has proposed that the metre should be raised to 40 inches. We have to suggest a much smaller change, which would nevertheless result in a very remarkable simplification. One proposal is to raise the metre from 39·37 inches to 39·6 inches. This change, which amounts to an alteration of much less than 1 per cent., would relate the metre with the Anglo-Saxon yard in the easily calculated ratio of 11 to 10, whilst complete harmony would be established between the larger measures of the two systems. Thus a mile would be exactly 1600 metres, an acre exactly 4000 square metres, etc.

Is it too much to hope that the Metric Convention might be induced to adopt this simple reform, the result of which would almost certainly be the immediate establishment throughout the world of one simple and uniform yet elastic system?

Printed by MORRISON & GIBB LIMITED, *Edinburgh*